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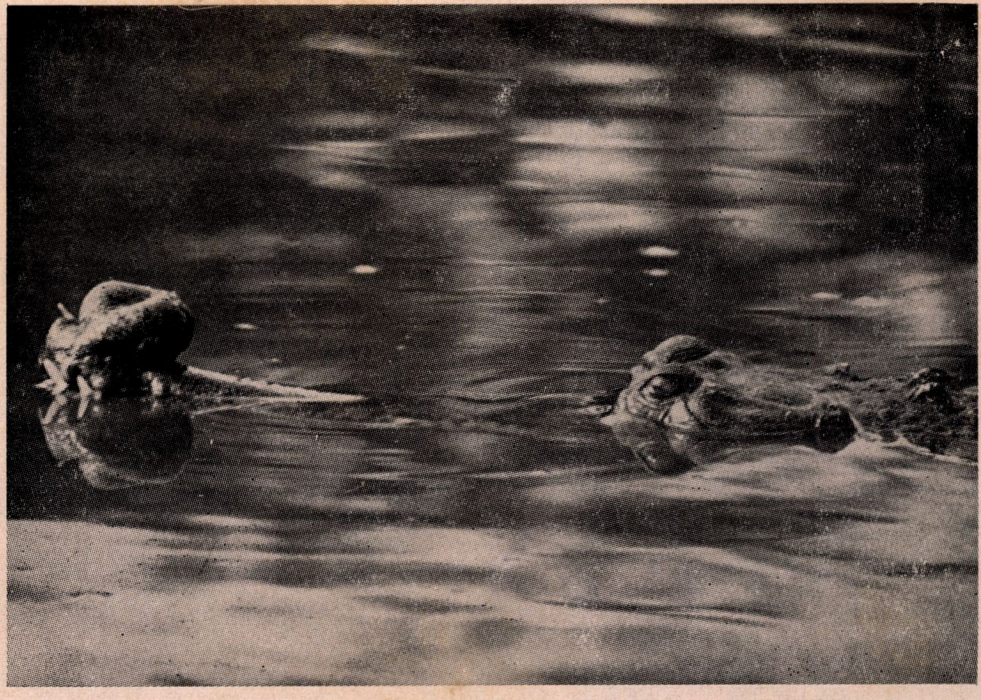
(Issued on the occasion of CITES Conference, New Delhi, Feb. 25th—March, 8th)

SHY SEROW, *Capricornis sumatraensis* —*Photo by Pratap Singh*

Plate I



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Notice

The 23rd Annual General Meeting of the Wildlife Preservation Society of India will be held in June 1981 at which the following office bearers will be elected for the next two years:

1. **President.**
2. **(a) Two Vice-Presidents from Dehra Dun.**
   (b) Four Vice-Presidents from different regions of India.
   (1) North-Delhi, (2) South, (3) East, (4) West.
3. **Honorary Secretary.**
4. **Honorary Asstt. Secretary.**
5. **Treasurer.**
6. **18 members of the Executive Committee.**

Members who wish to seek election are requested to send their biodata to the undersigned by 30th April 1981 for consideration of the Executive Committee.

Dr. R.N. Misra
Honorary Secretary

———

Appeal

The Wildlife Preservation Society of India has purchased the building, 7, Astley Hall and so now has a home.

Part of the purchase price has been paid and the balance has still to be paid. Patrons, Members, and sympathisers are requested to donate generously so that balance may be paid soon.

All donations are exempt under Section 80 (G) of Income Tax Act.

Donations, big and small, may please be sent to the Wildlife Preservation Society of India, 7, Astley Hall, Dehra Dun, U.P. (India).

All donations will be gratefully acknowledged and the names of donors published in CHEETAL.

PRESIDENT
and
The Executive Committee

CITES

The third meeting of the Conference of the Parties to the Convention on International Trade in Endangered Species of wild fauna and flora will be held in Delhi from 25th February to 8th March 1981.

The Government of India is the host.

Some fifty Government delegations are expected to attend and more than 40 Non Government organisations have registered as observers. The Wildlife Preservation Society is one of them.

Indian Board for Wildlife

The recently reconstituted Indian Board for Wildlife met on 9th February 1981 at New Delhi. There were many new faces at the meeting.

During years to come much is expected of the IBWL as Shrimati Indira Gandhi is the Chairman of the Board and as such the recommendations of the Board will have greater weight and are likely to be implemented rather than brushed aside. It is hoped that with the active interest of the Prime Minister and the executive ability of the young and dynamic member Secretary Shri Samar Singh conservation of Wildlife will have greater priority than ever before.

Ourselves

The Wildlife Preservation Society of India was founded in 1958 by a group of wildlife enthusiasts at the instance of Mr. P.D. Stracy (a Forest Officer) and Shri Pratap Singh Malvendra, former Maharaja of Nabha. The Society has been growing from strength to strength.

The two prestigious Wildlife conservation projects (1) Crocodile Project and (2) Project Tiger were initiated at the instance of two members of the Society at the IUCN meeting in New Delhi in 1969.

Another resolution was passed at the same IUCN meeting recommending the formation of a separate Wildlife Service and to start with the creation of a separate Wildlife wing within the Forest Service. This again was proposed by the delegates of the Society at the said IUCN meeting. The Society continues to be represented on the Indian Board for Wildlife and on many State Wildlife Boards and renders active and valuable advice. Thus the Society continues to play a cataletic role in the conservation movement in the country.

All India Photographic Exhibition 1981

The Society organised an All India Photographic Exhibition the theme being "Wildlife in Natural Environment". Nearly 400 exhibits were received. The following are the Prize Winners:—

Monochrome Prints

First Prize Rs. 500.00.....Shri Pratap Singh
SEROW.....a rare photograph

Second Prize Rs. 300.00.....Shri T.N.A. Perumal
"MOTTLED WOOD OWL"

Third Prize Rs. 200.00.....Shri Naresh Singh
"Four Horned Antelope"

Consolation Prize Rs. 100.00.....Shri B. Srinivasan
"Wild Elephant Mating"

Colour Slides

Second Prize Rs. 750.00.....Shri Shailendra
"Blackbuck"

Third Prize Rs. 500.00 .....Shri Pradeep
"Wild Buffaloes"

Consolation Prize Rs. 250.00.....Shri Amrit
"Sambar in Flight"

Consolation Prize Rs. 250.00.....Shri Sanghvi
"Flamingoes"

The entries were judged by an eminent panel of judges headed by Shri T. Kashi Nath.

Thirty one of these exhibits are being shown at Pragati Maidan, New Delhi on the occasion of Non-aligned nations foreign Ministers Conference and the CITES conference from 9th February to 5th March 1981. Srimati Indira Gandhi, the Prime Minister who visited the Exhibition showed keen interest in the Photographs.

A Rural Reminiscence

SAROJ RAJ CHOUDHURY

In my early boyhood, half a century back, marriage between 'bata' (*Ficus bengalensis* and 'aswastha' (*F. religiosa)* ceremony gathered round the ritualistic planting of the two saplings to grow up coalesced together in lifelong embrace and appear, as they grew, like one tree with properties of both, properties that would bestow multiple benefits to man, beast and bird—the deep shade of 'batabrukshya', the scothing whispers of 'pipal', the nourishing leaves and figs of both and addedly for many birds, beasts and reptiles, their homes. For man, it would not be the comfortable microclimate alone under their cool shade in summer. It would be much more. Together they would grow and spread out a microenvironment, salubrious, relaxing and refreshing enough to draw him in quiter moments and for friendly rendezvous. Such sobering influence of the silvan couple would lift the subconscious human feelings to higher levels of ethics. Planting and care of trees would be the emperical issue of such elevated feelings. It would inculcate a sense of trust for the future generations. The trust would then be handed down as a tradition. And the tradition would inevitably transcend over wider horizons of natural areas in the surround of our village homes.

We were born to such a state of rural living associated with octogenarian and centenarian couples of 'bata' and 'ashwastha' planted by our forefathers, a rationalised way of living that was by tradition integrated ecologically with the wildlife as our neighbours and their habitats in nature. Productive consumption of wildlife resources had favourable alignment of tolerable demographic impact and traditional ethics of conservation. Benefits of such compatible living with nature were multipodal and multifaceted—rarely recognised—usually taken for granted because of their natural flow in renewed abundance.

Sustainedly measureable benefits of wildlife come from their prominent spread in the forests. The term wildlife covers both plants and animals.

The wood, bark, latex, roots, foliage, flowers and fruits of plants provide materials for more than five thousand different products including cellulose, paper, spirit, furniture, lacquer, rayon, plastic, tiles and so on (1). In rural India—more than 80% of our people live in villages—trees from the backbone of environmental harmony and rural economy— health, home, hearth, food and fence, all included. They do more : in stretches as forests, they support stable agriculture, nourish agricultural land, regulate humidity province, may influence precipitation and maintain a clean and refreshing atmosphere. Measurements reveal that in temperate zone, on a warm sunny day, one hectare of forest builds up 120-150 kg of new organic substance absorbing 220-250 kg of carbondioxide from the air and turning out 180-220 kg of oxygen. Forests can absorb almost all the carbondioxide contained in a layer of air 45 m thick. In one year a single hectare of forest can filter out 50-70 tonnes

of dust from air (1). In tropical climate, sunny and warm almost through the year, these functions are far more dynamic and productive all the year round. This country has principally a tropical climate.

Animals grow on these year-round productive plants by direct herbivory and/or through indirect routes of carnivory. Like trees, many of them yield important products for the sustenance and comfort of human beings, including flesh, hide, horn, antler, pellage and plumage. The turnover potential in animals far exceeds that of trees. A seedling has to grow through many years to become a mature tree. A fawn becomes an adult in two years, a chick in just one year. Petrid and Swank, (1965) calculated the productivity of African elephants at 0.34 kcal/m2/year from a standing crop of 7.5 kcal/m2, respective values of beef cattle were 0.86 and 7.5 and for white tail deer 0.64 and 1.3 (Davis and Golley, 1963). The data on saiga antelope (*Saiga taterica*) of Russian steppes (Bennikov, 1961) analysed by Fredric H. Wagner (2) reveal a yearly increment of 0.20 kcl/m2 from a standing crop of 0.26 kcl/m2, i.e. nearly 80 percent. The turnover potential would be more in the deer and antelopes in this country and far more in birds.

Life equation studies on the Chilla cheetal (*Axis axis*) opposite Hardwar in U.P. by my students in 1970 through 1973 indicated an annual percentage of established increase as high as 45, assessed from the rates of fawnings and their recruitments into the stable yearling stages having the longest life expectancy. And much of these, I would emphasise, were the croppable animal growths after covering all natural drag factors in the total mortality including predation by tigers aed panthers. Consumable annual removal for human benefits, here, could be easily one in each three of the adults.

The range was optimally populated by cheetal, inferred from its estimated capacity in resource production and the forage-hectare requirement of cheetal. Discreet cropping alone would stimulate and maintain such high rate of growth. Else, there would soon be overpopulation of this density independent species which will overrun the habitat. The resultant increase in stress conditions may ultimately lead to the inevitable crash. The range decline was strongly suspected at the end of those studies. However, the local jackals who in the meanwhile picked up the habit of pack-predation on cheetal fawns and pregnant females might have applied the brake, later. But the point is; Should the nonontogenic new predator the scavenger jackal, be so allowed to ocoregulate, unwisely thus, to suck up the flow of croppable benefits ? Given such scope he would seriously cripple the growing end of the population and very soon spread his ammonsalistic curb on the predation success of the tiger the panther. This is the little recognised but highly significant difference between ecodevelopment through productive conservation of wildlife with educated insight and wisened farsight and the more popular but largely wishful concept of sessile preservation.

The former is the crux of Theodore Roosevelt's principle of 'Conservation through wise use', that the living resources of the land, in wildlife, could be knowledgeably moti-

vated through conservation to produce consumable benefits which could be derived indefinitely by consuming only so much as would be replenished by the growth. Further more, the two principal consequences of such purposeful conservation accepted in the draft for 'A World Conservation Strategy' compiled by IUCN in collaboration with UNEP and WWF are as follows.

(a) Physical and biological changes are only important if they affect human interest in any way; and

(b) the standard against which any action should be assessed is its lasting effect on human well-being.

The conservation principles enunciated by Roosevelt at the turn of the century and the conservation strategy proposed by IUCN *et al* more than half a century later converge at the penultimate, the lasting benefits to human beings. But, no conservation effort will have any lasting success without the active participation of the local people. It should induct them not only to participate in conservation efforts but also to realise its material benefits like it used to be in my village in those good old days. We had then seemingly unending flow of wood and meat and numerous other useful matter produced by plants and animals. Every weekend I alone used to get one animal, kakar, cheetal, sambar or wild boar, of which half went to our fellow villagers and the other half shared equally between me and my trackers. There were a few other hunters too from neighbouring villages who cropped the benefits. And we also used to have about a dozen sportsmen from the cities who brought the urban currency to the rural homes for services rendered for their permitted huntings. We had in those forests the elephants, the gaur, the tiger, the panther and also the wild dog. And we used to get one or two tigers and equal number of panthers every year, mostly in sports hunting and sometimes to eliminate a cattle-lifter or man-eater.

With all those seemingly heavy cropping, there was apparently no evidence of depletion in any of the structural components of that ecosystem which continued to provide us with consumable wood and animal. Moreover it kept the streams alive throughout the year and it also nourished our crop fields with the rains runoffs enriched by nutrients carried in the disintegrated dung and detritus from the forest floor. The abundant flow of fertile water generated flourishing populations of fish, crab and snail all of which were high proteinous food for the people who ate them fresh through the rains and dried or smoked fish long into the winter. Ours was indeed a very peaceful and happy community life, well integrated into the natural ecosystems around us.

And, then came the second world war, and with it the repeater and automatic weapons, the jeep and the spot light. The local gun-man saw the impending deluge of depletion and he too lost no time in plunging into the competition. And in the process he and his covillagers very soon lost all count of traditional values of the ecorationales in their behaviour with nature.

By mid-50's all was gone, the animal first and then the woods. The nature surround of my village has then on became an increasing expanse of dreary destitution, of howling barrens and tangled weeds. The streams have dried up. The transition ecosystems of dynamic properties in crop fields with their former abundance in aquatic life have been sterilised for animals with heavy application of stable weedicides. Grain and insect eating birds and their predators have been affected. Productivity of the land here has been channelled principally to increase high yielding, not necessarily resistant, races of crop grown largely in medicated laboratory conditions, not by harnessing the appropriate ecological forces of lasting virtues. Flow of protein in the water has well nigh dried up. And life in my village has changed drastically to the worse, centripeting from its wider community outlook to narrower individual greed and competition.

A sad reminiscence indeed, of one who grew up with his eyes open and ears attentive to nature. A village lad then. Now a professional forester on the verge of retirement. A sample reminiscence of what has happened in just one brief life time, a moment in nature's infinite time-scale. A sample, by and large, true to most villages in this country.

The genesis of the problems is obvious in that history of the ecoretrograde in my village. Factors and influences that accelerated and expanded the degradation are apparent. These have been stated with the backdrop of what the conservation potential is in this tropical land to yield unending benefits to the rural home and also the urban life.

The young man, Sanjay, with subtle sensitivity to nature who conceived of the main key to the remedy, sleeps peacefully at Santiban. The only way to reinculcate the traditional care for the tree which he visualised is : Plant them, plant them more and more at every available space; plant the ontogenic indigenous, not the exotic from far away lands; make more land available to the trees; curb your demand on land by cutting down your own rate of growth; take the practice to the people at state cost; induct them to participate; and raise it to the sanctity of a ritual. The trees will take care of further reconstruction to provide appropriate niches for the wildlife. And no niche in nature remains vacant unless the related species has been totally wiped out. It is a slow process both with the trees and the people, slow and long protracted in human measures, not in nature's, nor in nation's. May we not remain oblivious to the obvious : Animals in this planet exist only, and only, because of trees.

Reference

1. Kulacov, Konstantin, 1973. The forest—our common domain—is man's green friend. Life and Culture (1/73, P. 25) Moscow.
2. Van Dyne, George M. Editor 1969. The Ecosystem Concept in Natural Resources Management, Academic Press, New York and London (P. 284).

Geographic Variation in The Barasingha or Swamp Deer (*Cervus duvauceli* Cuvier, 1823)

By

M.K. Ranjitsinh

Ellerman and Morrison-Scott (1951) in their influential checklist recognise two subspecies of the barasingha: *Cervus duvauceli duvauceli* Cuvier, 1823 for northern and northastern India (and Nepal), and *Cervus duvauceli branderi* Pocock, 1943 for central India. If carefully observed, however, the physical appearance of the barasingha of Assam differs sufficiently, from that of the same species in northern India and Nepal to warrant recognition as a third subspecies.

Pending the time that such a classification can be formalised, I will make bold to refer to the three populations as the northern, eastern and southern races of the barasingha. The distinguishing characters of all three are described below in some detail as I have not come across a discussion of the subject in print.

The barasingha stag of the northern race, locally called "gond", is on average about 5 cm. taller and slightly heavier than that of the southern race. and has a slightly longer skull as indicated by Pocock (1943). But the difference in size between the hinds of the two races is much more prominent, the "gond" hind being not only noticeably taller and more heavily built, but having a much thicker neck.

The southern barasingha stag has a considerably darker rutting pelage, a better developed ruff on the neck and on average a longer pair of antlers then either of the other two races.

The hooves of the eastern and northern races are more elongated, an adaptation to their more swampy habitat (Dunbar Brander, 1923). The tail of the northern race is slightly slimmer but longer, and has a much more prominent growth of white hair on the inside of the tail.

The barasingha of the eastern race are of the same height as those of the southern race but slightly heavier in build. The antlers are by far the shortest in length of the three, and the main beam tends to bifurcate into two branches to throw up points much lower down the beam. There is a distinct tendency for a degree of palmation in the antlers, and all antlers of this race that I have examined appeared to be slightly flattened and less cylindrical than those of the other two races. The ears of the eastern barasingha have very little white hair on the insides unlike those of the other two races; they are also smaller in size, less rounded and with a distinct point. In the moult, the white spots along the dorsal lines

are much less prominent than in the southern race under similar circumstances; and the tail is the shortest of the three races.

Specimens of the undescribed eastern subspecies are believed to be available in collections; and a project to seek out and study such specimens, and describe and name the new race, is to be undertaken in collaboration with C.P. Groves. In the mean time it is worthwhile to draw the attention of readers of this journal to its existence.

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Dunbar Brander, A.A. 1923. *Wild Animals in Central India.* Arnold, London.

Ellerman J.R. and Morrison-Scott, T.C.S. 1951. *Checklist of Palaearctic and Indian Mammals.* British Museum (Trustees), London.

Pocock, R.I. 1943. The larger deer of British India. Part II. *Journ. Bombay Nat. Hist. Soc.* 43:553-572.

DANGEROUS ENVIRONMENTAL SITUATIONS TODAY

About half of the world's rain forests have been destroyed, and the current rate of depletion is between five and ten million hectares a year.

More than two thirds of the world's fisheries breeding grounds and coastal litteral are being degraded or destroyed.

As many as 1,000 animals and 25,000 plant species are threatened with extinction.

The earth's atmosphere, soils, rivers and seas are being increasingly polluted by toxic chemicals, agricultural run-offs, the dumping of hazards wastes, the carbon dioxide build-up and acid rains.

The search for a substitute for oil based energy, the liquifaction of coal could lead to an even greater release of carbon-di-oxide in the atmosphere and the greater use of crops for alcohol production implies, among other things, a serious land use competition in terms of fuel or food production. An area of about six million hectares of arable land is lost to desertification every year. In India, an estimated six billion tons of soil is washed away each year in one quarter of the country.

The Government of India Crocodile Project

By

Dr. H.R. Bustard*

Chief Technical Adviser, Crocodile Breeding and Management Project

By 1970, the gharial was thought to be on the verge of extinction and the saltwater crocodile and Indian mugger were known to be becoming increasingly rare. However, no country-wide survey had been carried out and there was no indigenous knowledge about how to proceed in order to save this valuable economic resource. With a view to conserving the crocodilian species and then developing crocodile farming, the Government of India approached UNDP for assistance. Following a consultancy visit report by Dr. H.R. Bustard in 1975, the Government of India requested the return of the Consultant in 1975 to assist implementation of the project initially in Orissa. This work started on 1.4.1975. Gharial eggs were collected from the wild and hatched for the first time in captivity at Tikerpada, Orissa in June 1975. An account of this work and the early development of the Project was given in Cheetal (Bustard 1975; 1976) and as an FAO Report (FAO 1975),

Orissa was followed by the following states (the year of joining the project is bracketed):

Uttar Pradesh (1975), Rajasthan (1975), West Bengal (1976), Tamilnadu (1976) and Andhra Pradesh (1976).

By the end of 1976, therefore, six states had joined the project with a total of eleven schemes (Orissa 4, Tamilnadu 2 and other states 1 each).

Crocodile husbandry by the Project had achieved the following production of crocodiles:

Gharial	512
Saltwater crocodile	210
Mugger	250

Concurrently work had been taken up on the declaration and management of special sanctuary areas into which crocodiles produced in the Project could be released and be safe from poaching activity and other disturbances. During this period sanctuaries were declared as follows:

1. Ranapratap Sagar Wild Life Sanctuary (Rajasthan)—for gharial—1975.
2. Bhiterkanika Wild Life Sanctuary (Orissa)—for saltwater crocodile—1975.
3. Katerniaghat Wild Life Sanctuary (Uttar Pradesh) for gharial—1976.
4. Satkoshia Gorge Wild Life Sanctuary (Orissa)—for gharial—1976.

*Central Crocodile Breeding and Management Training Institute, 19-4-319 Lake Dale, Hyderabad-500 264,

In the early phase, training was on-the-spot by regular visits to the Projects by the FAO Expert.

The Project Headquarters moved to Hyderabad effective 10.1.1977. The main achievements since then fall into two categories, each of which can be considered under the following heads :

A. *Crocodile Conservation and Management including development of "crocodile" sanctuaries*:

(i) Increased husbandry in an increased number of states (the demand by states to join the project has been much greater than the Project has been able to cope with, with its limited staff, with the result that a number of states have now been waiting for several years).

(ii) Sanctuary declaration and development.

(iii) The effects of (i) and (ii) above on the status of the three Indian crocodilian species.

(i) Husbandry—The number of states in the Project grew to nine with the addition of the following states to the six already participating: Gujarat (1977), Kerala (1977), and Madhya Pradesh (1978). In addition, a number of other states have started state schemes yet to be given central assistance. Among them are Maharashtra and the Union Territory of the Andamans. The following states have expressed interest in joining the Project (see also under Part B)—Assam, Arunachal Pradesh, Bihar and Nagaland.

(ii) Sanctuaries—The number of Project sanctuaries has increased to eleven with the addition of the following :

5. Ethipothalla Wild Life Sanctuary (Andhra Pradesh)—for mugger—1976 (this sanctuary has now been incorporated into the Krishna Wild Life Sanctuary).
6. Lanjumadugu Wild Life Sanctuary (Andhra Pradesh)—for mugger—1978.
7. Manjira Wild Life Sanctuary (Andhra Pradesh)—for mugger—1978.
8. Papikanda Wild Life Sanctuary (Andhra Pradesh)—for gharial—1978.
9. Coringa Wild Life Sanctuary (Andhra Pradesh)—for saltwater crocodile—1978.
10. Krishna (Nagarjunasagar—Srisailam) Wild Life Sanctuary (Andhra Pradesh)—for mugger—1978.
11. Chambal National Gharial Sanctuary in the states of Uttar Pradesh, Madhya Pradesh and Rajasthan—for gharial—1979.
12. Hadgarh Wild Life Sanctuary (Orissa)—for mugger—1979.

Quite apart from the above sanctuaries, specially gazetted under this Project, crocodile management and wild life management is going on in a number of existing sanctuaries in the country including for instance Gir National Park in Gujarat, Shivpuri National Park in Madhya Pradesh and Kinnersani and Pakkal Wild Life sanctuaries in Andhra Pradesh. Furthermore, the effect of the Project sanctuaries goes far beyond their number. The Project is pioneering a completely new approach to sanctuaries, which in the past tended to come up haphazardly, and to often be of small size, with the result that they were not viable. The crocodile Project has selected areas very carefully, delineated biological boundaries wherever possible, and made sure that the areas are large enough to be viable when the surrounding forest areas outside the sanctuary may be lost to cultivation. Hence, at the time of its declaration, Krishna Sanctuary was the largest in India (3,600 sq. km.)—and as well as providing for the Indian mugger in the state, encompasses the state's prime tiger habitat and largest tiger population as well as many other endangered species of Indian wild life. The Chambal National Gharial Sanctuary in the states of Rajasthan, Uttar Pradesh and Madhya Pradesh has dwarfed even the Krishna Sanctuary with a total of 12,568 sq. km. (8,351, 3,502 and 635 sq. km.) in Rajasthan, Madhya Pradesh and Uttar Pradesh respectively.

Equally important as the gazettement of the sanctuaries is their management. One FAO input is the preparation of two model Sanctuary Management Plans for the country which can readily be adapted by counterpart staff to other existing and proposed sanctuaries. For this purpose, two areas have been selected, one in north India—Chambal National Gharial Sanctuary and one in the south—the Krishna Sanctuary of Andhra Pradesh. In addition, sanctuary management advice is being provided as required to other Project sanctuaries.

The effect of (i) and (ii) on the status of India's three species of crocodilians has been dramatic:

(a) *The Gharial* (*Gavialis gangeticus*)—on the verge of extinction in 1974, has been turned around. Protection of the remants—down to less than 70 in the entire country in 1974—combined with protective incubation of all nests laid and protective rearing of the young has resulted in almost 3,000 being hatched by the Project. Gharial are about three years old when at a size of 1.2 metres (4 ft.) they are returned to the wild. Already 224 gharial have been rehabilitated into the specially gazetted project sanctuaries. Gharial do not breed until they attain an age of about 10 years. Hence, it will be around 1985, that with the commencement of large-scale breeding in the wild, the gharial can truly be said to have been completely saved. Very few countries have ever saved such an endangered animal. This is the first time the United Nations have been invoived in such an instance also. The next few years will be critical for the gharial—achievements must be consolidated, and effective management teams must be built up for the sanctuaries gazetted.

(b) *Saltwater Crocodile* (*Crocodylus porosus*)—the saltwater crocodile formerly had an extremely wide range in Asia and the Pacific, extending from Cochin in West to South China in the East, and South-east through Indonesia, the Philippines and Papua—New Guinea to Northern Australia. In all of these areas it is now extinct or endangered. The activities of this Project make it likely that the Indian population of this species—which has the best commercial hide in all of the world's crocodilian species—will survive. The saltwater crocodile has suffered not only from intensive hunting for its valuable hide but also due to encroachment of its mangrove habitat. Hence, in this case, sanctuary management aspects, together with the close interest of the Government of India, are essential to ensure this species' survival. Technically the Project has already the capacity to save this species but this will not take place in practice unless effective protection is assured to the sanctuaries in which it lives.

(c) *Indian Mugger* (*Crocodylus palustris*)—although greatly depleted in numbers, the Indian mugger was never endangered. Furthermore, it is the most widespread species of Indian crocodilian. The Project, operating along similar to those used successfully with the above two species, is increasing the number of this species with the view to making it the first species which can be declared to be safe from extinction and made available, under adequate controls, for commercial exploitation.

(iii) *Numbers rehabilitated into the wild*:

As of November 1980, 725 crocodilians (comprising 324 gharial, 168 saltwater crocodiles and 233 mugger) have been rehabilitated into the wild. The results of these rehabilitations have been excellent. Large-scale releases, following on several years of pilot release to enable detailed monitoring, only commenced last winter. This will now be an annual feature. The numbers so far released exceed the total wild population of gharial and saltwater crocodiles in the entire country in 1975 when this project was initiated.

B. *Training*:

Following the move to Hyderabad, the Government of India decided to set up a centralised training institute. The Central Crocodile Breeding and Management Training Institute is the result.

This Institute took in its first trainees in 1978 and has been running an annual nine months training course for in-service officers since then. The calibre of the trainees offered has been very good, many holding post-graduate degrees. The aim of selecting young candidates with an interest in wild life and ensuring that they are passed back to the wild life wings of their respective state forest departments after completion of training, has been a great success—out of 25 candidates who have so far completed training, all 25 are now engaged in

wild life work in their respective states. To date the following states have sent trainees (those marked thus (*) are not so far states associated with the Project) : Andhra Pradesh, Tamilnadu, Kerala, Uttar Pradesh, Madhya Pradesh, Arunachal Pradesh*, Gujarat, Assam*, Nagaland* and Bihar*. A trainee was also received from the Kingdom of Bhutan. There is a need to provide extension services to the interested states (six in number) so far not assisted by the Project.

The existence of this Institute provides a focus for crocodile work in the country. The training programme, as a necessity, has already embraced sanctuary management, as the crocodilians, on return to the wild, must be effectively protected in the specially gazetted sanctuaries, if they are not to be lost, as happened prior to the initiation of the Project. The training course has also covered wild life management generally, although on the completion of the current course it is hoped to focus, in more detail, on the main Project activities—breeding and management and also on the applied aspects of crocodile breeding.

Another aspect of training, initiated from the very outset of this Project, has been training at Ph.D. level. Seven suitably qualified candidates have undertaken Ph.D work under the supervision of Dr. H.R. Bustard through their authorised state universities. The first Ph.D. was awarded earlier this year. The aim of the Ph.D. training is to transfer the best international levels of knowledge on all aspects of crocodile breeding and management to Indian personnel so that in the future the country will be fully self-sufficient in this technology. While this is of necessity a task spread over many years (an ecological Ph.D. takes about five years) the end result is far more satisfactory from a National point of view.

Summary

This Project has been instrumental in saving the gharial—found only in the Indian sub-continent—from extinction, and is building up one of the very few populations of the saltwater crocodile which is likely to survive in the world. The saltwater crocodile has the best hide of all of the world's crocodilians. The Project is also rehabilitating the Indian mugger. These activities have been paralled by large-scale training both at the in-service level (Diplomas) as well as at the highly technical and scholastic Ph.D. level. The Central Institute, suitable strengthened, should be able to lead in the development of commercial crocodile farming in the country, while ensuring that the admirable conservation phase, which has won India international praise, is continued.

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घड़ियालों का लालन—पालन

श्याम लाल

भारतवर्ष में मगर तथा घड़ियालों की तीन प्रजातियाँ पाई जाती हैं। इनमें से दो प्रजातियां उ०प्र० में पाई जाती हैं पहला मगर(Corcodilus palustris)दूसरा घड़ियाल(Gavialis gangetias)खारे पानी का मगर (C. porosus) प्रदेश में नहीं पाया जाता है। उक्त दो प्रजातियों को स्थानीय भाषा में मगर, मगरा, नाका इत्यादि कहा जाता है। दोनों प्रजातियां प्रदेश की सभी मुख्य-मुख्य नदियों में पाई जाती थी, जैसे गंगा, जमुना, चम्बल, घाघरा, रामगंगा तथा इनकी सहायक नदियों में जहाँ पर यह हज़ारों की संख्या में पाये जाते थे। मगरों की खाल बहुमूल्य है जो विदेशों में निर्यात की जाती रही है आज भी विदेशों में इसकी बड़ी मांग है। इसी लिये स्थानीय जनता ने इस असहाय रेंगने वाले उभयचर का वध बहुताप में किया। जिसके फलस्वरूप सभी मगर व घड़ियाल लुप्त प्रायः हो गये। अब केवल चम्बल तथा गिरुवा नदी में गिनती के घड़ियाल रह गये हैं। १९७५ में प्रदेश में इनकी संख्या सब, छोटे बड़े मिलाकर ५८ रह गई थी जिनका विवरण निम्न प्रकार है :—

१	गिरुवा नदी	—	२८
२	चम्बल नदी	—	१०
३	गंगा नदी	—	४
४	घाघरा नदी	—	५
५	राम गंगा	—	९
६	नारायणी	—	२

इस प्रकार इस लुप्तप्रायः उभयचर की सुरक्षा की तरफ जब शासन का ध्यान गया तो इनकी सुरक्षा हेतु कदम उठाये गये और घड़ियाल तथा मगर को संरक्षित जन्तु करार किया गया तथा प्रदेश में घड़ियाल पुनरुत्पादन परियोजना वर्ष १९७५ से प्रारम्भ की गई। तथा इनकी कतर्नियाघाट पशु विहार एव राष्टीय चम्बल पशु विहार की स्थापना की गई।

मगर चूंकि डरावना व खतरनाक होता है इसलिये वह अपनी सुरक्षा कुछ हद तक स्वयं करने में सक्षम है परन्तु घड़ियाल केवल मछली खाता है अतः वह अपनी सुरक्षा करने में असमर्थ है इसलिए घड़ियालों के पुनरुत्पादन पर शासन द्वारा अधिक ध्यान दिया जा रहा है।

घड़ियाल एक रेंगने वाला उभयचर है जो देखने में छिपकली (गोह) की तरह लगता है जिसका थूथन लम्बा होता है। परन्तु इनका आकार भीमकाय होता है। साधारणतया यौवनावस्था में ५ से ८ मीटर तक लम्बे होते हैं। अधिकतम लम्बाई १० मीटर तक पाई गई है। इनमें नर तथा मादा घड़ियालों में बाहरी रूप से ८–९ वर्ष तक कोई विशेष अन्तर नहीं दिखाई देता है परन्तु युवा नर घड़ियाल की थूथन में एक घड़ा Nose Hump बन जाता है। जिसके फलस्वरुप इसे दूर से पहचाना जा सकता है। एक नर घड़ियाल ३–४ मादा घड़ियालों को साथ रख कर अपना परिवार चलाता हैं। इस प्रकार इनमें बहुपत्नी प्रथा पाई जाती है। घड़ियाल लगभग १० वर्ष की अवस्था में युवा हो जाता हैं। युवा घड़ियाल जाड़ो के अन्त मे मैंथून करते हैं तथा गर्मी आरम्भ होते ही

मादा नदी के किनारे ३०° से ६०° के बीच ढालू वाले किनारे में मार्च अन्त में, अप्रैल के प्रथम सप्ताह तक चढ़ना आरम्भ करती है और बालू ३० से ५० से० मी० की व्यास के गोलाकार गड्ढे खोदना आरम्भ करती है और दूसरे शब्दों में घोंसले बनाती है। इस प्रकार वह १०–१५ गड्ढे खोदती है और इन गड्ढों में से किसी एक में वह अपने पिछले धड़ को डालकर अण्डे देती है सभी अण्डे एक साथ दिये जाते हैं। चम्बल नदी में अण्डे देने की तिथियाँ ६ अप्रैल से १० अप्रैल तक पाई गई है। यह मिथ्य घोंसला Pseudonest वह अपने दुश्मनों (गीदड़) इत्यादि से अपने अण्डों की सुरक्षा के लिए खोदती है। एक बार में एक पूर्ण प्रौढ़ मादा १० से १०० तक अण्डे देती है अभी तक प्रदेश में अधिकतम ९७ अण्डों को घोंसला में पाया गया है। घोंसलों की सुरक्षा हेतु मादा तथा नर दोनों नदी में घौंसले के निकट ही रहते हैं और रात्रि में घौंसले के पास बैठे देखे गये हैं। घड़ियाल के अण्डे गोलाकार होते हैं इनकी लम्बाई १०-१२ से०मी० तक चौड़ाई ६-८ से० मी० होती है जबकि मगर के अण्डे बेलनाकार तथा घड़ियाल के अण्डों से छोटे होते हैं। बालू की गर्मी तथा नमी में अण्डे के भीतर भ्रूण बढ़ता जाता है और ६०-७० दिन में अण्डों से बच्चे निकल आते हैं। बच्चे निकलने की तैयारी की सूचना मादा घड़ियाल को बच्चों द्वारा प्राक्रिय आवाज से मिलती है। जिसे सुनकर मादा घौंसले की बालू हटाती है, बच्चे स्वयं अण्डे से निकल आते हैं। जो अण्डे स्वयं नहीं टूट पाते हैं उन्हें मादा घड़ियाल अपने मुंह से तोड़ती है। मादा बच्चों को अपनी पीठ पर तथा साथ लेकर पानी में ले जाती है जहाँ वह उनकी सुरक्षा अगली मैथून ऋतु तक करती है। इतने पर भी अधिकतर बच्चे मछलियों, सियारों, परिदों तथा स्वयं घड़ियालों के भोजन हो जाते हैं। इस प्रकार प्रकृति में बहुत कम बच्चे जीवित रह पाते हैं।

उपरोक्त प्रजनन की प्राकृतिक प्रक्रिया को ध्यान में रखते हुए वन्य जन्तु (संरक्षण) संगठन, उत्तर प्रदेश के माध्यम से लखनऊ के निकट कुकरैल में तथा बहाराइच जिले में कर्तनियां घाट पर घड़ियाल पुनरुत्पादन केन्द्रों की स्थापना की गई। प्रदेश की चम्बल तथा गिरूवा नदियों से अण्डे जमा किये गये।

माह मार्च के अन्त में मादा घड़ियालों की घोंसले खोदने एवं बालू पर चढ़ने की क्रिया का रात दिन निरीक्षण किया जाता है और अण्डों वाले घौंसले को खोदकर अण्डे खोजे जाते हैं। चम्बल नदी में पिछले तीन वर्षो से अप्रैल की ६-७ तारीख को घड़ियालों द्वारा अण्डे लिये जाते जिनकी सुरक्षा घड़ियालों के कर्मचारियों द्वारा भी कराई जाती है। अण्डे मौके पर लगभग एक माह तक रखे जाते हैं। उसके बाद उन्हें खोद कर निकाल लिया जाता है। अण्डे निकालते समय इस बात का ध्यान दिया जाता है कि अण्डे जिस स्थिति में दिये गये हों उसी स्थिति में उठाकर बक्सों में रखे जांय। इस लिए प्रत्येक अण्डे को उठाने के पूर्व चिन्हित किया जाता है। जिन घौंसलों का नदी में पानी बढ़ जाने के कारण बह जाने अथवा डूब जाने का भय होता है तो उनसे अण्डे घौंसले के खोदते ही निकाल कर पुनरूत्पादन केन्द्रों में लाकर हेचरी में रख दिया जाता है। हैंचरी की बालू का तापक्रम व आर्द्रता प्राकृतिक बालू के समान रखा जाता है। जो २७°से० से ३४° से० तक रहता है। सभी घोंसलों से अण्डे निकाल कर हेचिंग बक्सों में रख कर पुनरुत्पादन केन्द्रों पर लाया जाता है जहाँ उन्हें हेंचिंग के लिए बनाए गये ह्वेचरी में दबा दिया जाता है। हेचरी का तापक्रम तथा आर्द्रता आवश्यकतानुसार बनाये रखना पड़ता है। ६०-७० दिन हो जाने पर भ्रूण तैयार हो जाता हैं और सरसराहट की आवाज आने पर ऊपर की बालू हटा दी जाती है, बच्चे स्वयं अण्डे तोड़कर बाहर निकल आते हैं निकले बच्चों को शुद्ध जल से भरे छोटे-छोटे पाण्डों में डाल दिया जाता है तथा उन्हें जीवित अथवा मरी छोटी-छोटी मछलियाँ खिलाई जाती हैं।

अण्डे जमा करने का कार्य प्रदेश में वर्ष १९७५ से आरम्भ किया गया तथा हैचिंग में ९० प्रशित तक की सफलता प्राप्त हो चुकी है। जिसका विवरण निम्न प्रकार है :—

वर्ष	नदी जिसमें घौंसले खोदे गये।	घौंसलों की संख्या	अण्डों की सख्या	बच्चों की संख्या जो पैदा हुए	बच्चे प्रतिशत में	अगस्त १९८० तक बचे बच्चों की संख्या	पालन प्रतिशत	विवरण
१	२	३	४	५	६	७	८	९
१९७५	चम्बलर/गरुवा	१	३८	२१	५५.३	१२	५७.०	१९९
१९७६	,, ,,	१०	४५८	३६४	८०.२	२३५	६४.६	घड़ियाल
१९७७	,, ,,	१८	७१२	६३२	८८.९	३३४	५५.८	घड़ियाल
१९७८	,, ,,	१६	६२७	४२३	६७.५	२३६	५५.८	नदी में वर्ष
१९७९	,, ,,	१५	६०२	४९२	८१.७	२३६	४८.०	१९७९ व
१९८०	,, ,,	११	४४०	३७३	८४.८	३४४	९३.६	१९८०

में छोड़े गये जो इस तालिका में सम्मिलित हैं।

अभी तक का यह अनुभव है कि मादा मगर जिस स्थान में एक बार अण्डे देती है हमेशा उसी स्थान पर अण्डे देती है। यदि भू-क्षरण के कारण अथवा अन्य कारणों से घौंसले वाला स्थान नष्ट हो जाता है तो उसी के निकट उचित स्थान खोजकर घौंसला बनाती है। अतः घौंसलों को खोजने का कार्य प्रथम वर्ष ही कठिन होता है। बाद में सफलता से समय पर निरीक्षण करने पर घौंसले खोजे जा सकते हैं।

जब बच्चे निकल जाते हैं और पोण्डों में छोड दिये जाते हैं तो ऐसे पोण्डों में प्रत्येक तीसरे दिन सफाई की जाती है और स्वच्छता का विशेष ध्यान दिया जाता है रोज सुबह पाण्डों से बची मछलियां निकाल दी जाती हैं तथा उसके बाहर चारों ओर बालू साफ कर दी जाती है। बच्चे धूप सेंकने के लिए बालू पर आ जाते हैं। तथा अधिक गर्मी लगने पर पानी में चले जाते हैं। ऋतु के अनुसार बच्चों को उनके भार का दो प्रतिशत से लेकर ५ प्रतिशत तक भार के बराबर मछलियां खिलाई जाती हैं। शीत रक्त का जन्तु होने के कारण यह जाडों में कम भोजन करता है तथा गर्मी में अधिक। इस प्रकार जाडों में २ प्रतिशत भार मछली दी जाती हैं जो मार्च ३ प्रतिशत, अप्रैल में चार प्रतिशत तथा मई से सितम्बर तक ५ प्रतिशत बढ़ा दिया जाता है। घड़ियाल शावकों को आकार के अनुसार अलग पाण्डों में रखा जाता है क्रमानुसार लगातार उनकी लम्बाई तथा भार किया जाता है। जिसके फलस्वरुप उसकी बढ़ोत्तरी का पता लगता रहता है।

तीन वर्ष की आयु में शावकों की लम्बाई लगभग २ मीटर हो जाती है तथा भार लगभग २० कि० ग्रा० हो जाता है। इसी अवस्था पर इनको नदी में छोड़ना अति उत्तम है क्योंकि तब यह अपनी सुरक्षा अच्छी तरह कर स्वयं अकेले में सक्षम हो जाते हैं और बाढ़ से बहने नहीं पाते हैं।

बच्चों को नदी में छोड़ने के पूर्व पकड़ कर उनकी लम्बाई, भार नापी जाती है। उनके लिंग की जाँच की जाती है और यह प्रयत्न कियां जाता है कि घड़ियालों को कम से कम मादा तथा नर के ३:१ अनुपात में छोड़ा जाय। उपरोक्त मापों के अतिरिक्त घड़ियालों के ऊपरी क्रष्ट चित्रानुसार काटे जाते हैं जो उनके छोड़ने का स्थान तथा वर्ष दर्शाती हैं। इससे हम प्राकृतिक तथा पाले गये घड़ियालों को नदी में अलग-अलग पहचान सकते हैं। इसके बाद घड़ियालों को लकड़ी की पेटियों में बन्द कर दिया जाता है, ट्रक में लाद कर नदी तट पर ले जाकर छोड़ा जाता है। छोड़ते समय यह देखा गया है कि कुछ घड़ियाल बक्सा खुलते ही दौड़ कर पानी में चले जाते हैं। और कुछ २-३ मिनट बक्से में पड़े रहते हैं और उसके बाद छोड़कर पानी में चले जाते हैं कुछ ५-१० मिनट तक बक्से में रह जाते हैं। तब उन्हें बाहर निकाला जाता है। कुछ बक्से से निकालने के बाद पर बालू पर बैठे रहते हैं। बालू में दो मिनट से लेकर ३० मिनट तक शावक बैठे रहते देखे गये हैं।

पानी में छोड़ते समय सुरक्षित स्थान का चयन किया जाता ह। जहाँ से बाढ़ आने पर बच्चे बहने न पायें यदि बह भी जांय तो निकट ही रुक जांय। सुरक्षित स्थान जहाँ पर नदी में घूम हो, नदी में नाले मिलते हों अथवा वहाँ पर रुका पानी BackWater पाया जाता हो माने जाते हैं। तथा जहाँ पर अधिकतम सुरक्षा उपलब्ध हो।

पानी में छोड़ने के बाद १-२ दिन तक घड़ियाल छोड़े गये स्थान के निकट ही पाये जाते हैं परन्तु बाद में ऊपर तथा नीचे की तरफ सुरक्षित स्थानों में चले जाते हैं। अभी तक देखा गया है कि बच्चे छोड़े गये स्थान से २-३ कि०मी० ऊपर की तरफ तथा ५-६ कि०मी० नीचे की तरफ चले गये हैं।

घड़ियालों को नदी में छोड़ने का कार्यक्रम अप्रैल १९७९ से आरम्भ किया गया तथा अब तक १९९ घड़ियाल छोड़े जा चुके हैं। जिनका विवरण निम्न प्रकार है :—

छोड़ने का वष	नदी जिसमें छोड़े गये	छोड़े जाने का समय	छोड़ने वाले स्थान	कुल संख्या	विवरण
१९७९	गिरुवा	अप्रैल १९७९	अम्बाघाट	१४	उ०प्र०।
	चम्बल	मई १९७९	कर्तनियाघाट पशु विहार, जेवराघाट		
			राष्ट्रीय चम्बल पशु विहार।	१५	उ०प्र० म० प्र० सीमा
				२९	
१९८०	चम्बल	दिसम्बर १९७८	जेबराघाट	३०	,,
		नवम्बर १९७९	वरेण्डाघाट	४५	,,
		फरवरी १९८०			
		मार्च १९८०-	वेलराघाट	४५	,,
		मार्च १९८०	पूरेनीघाट	५० म०प्र०	राजस्थान सीमा
				योग १७०	

घड़ियाल शावक की सुरक्षा तत्परता से की जा रही है। अभी तक किसी प्रकार की दुर्घटना की सूचना प्राप्त नहीं हुई है। घड़ियाल सभी स्थानों पर सुरक्षित हैं।

टिप्पणी:— इस वर्ष चम्बल नदी से ३३ घड़ियाल शावकों को पकड़ कर कुकरैल पुनरुत्पादन केन्द्र में पोषण हेतु लाया गया है।

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Desert National Park for Rajasthan

A Desert National Park is being established in Jaisalmer and Barmer Districts to preserve the fast vanishing flora and fauna and to regenerate the natural ecosystem of Thar desert.

It is in addition to the existing 200 sanctuaries and 19 National Parks and eleven Project Tiger areas.

Nanda Devi Sanctuary

In Garhwal Himalayas, Nanda Devi Sanctuary is being converted into a National Park for saving the High Altitude flora and fauna. A Director and his staff has been appointed and they have started drawing up a plan of work.

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Tiger Conservation

Its Objectives, Management Strategies & Achievements (In India)

By

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1. INTRODUCTION

Indian Tiger—(*Panthera tigris* Linn. 1785) has always been the centre of attraction in the Indian jungles and as a big game, it has over centuries, drawn attention of hunters, including local Maharajas, Nawabs, Civil Servants and administrators.

Tiger—the largest land carnivore, is known as "The Phantom of the Forest" and is characterised by versatility of adaptive secretiveness, strategic abilities and sudden spurt of speed and power. It is the master predator with an aura of mystery and power, and has been held from time immemorable as an odd mixture of awe, developing into fear and to hypnotic reverence, and even apathy towards acute antagonism.

Many legendary tales and folklores have been centred around this queer image of the tiger throughout the Indian sub-continent.

Tiger in its march of evolution has always remained as an Asiatic animal. In 1972 the tiger has won the general opinion poll and regained the status of National Animal of India.

1.1. Genesis of Project Tiger:

1.1.1. IUCN's Resolution to Save Tiger:

In the 10th General Assembly of the International Union of Conservation of Nature and Natural Resources Conference, held in New Delhi in December, 1969, a resolution calling for a moratorium on killing of Tigers was adopted unanimously. This very important resolution of IUCN generated effective impact on all the concerned governments, to impose ban on killing tigers in their respective jurisdiction. As follow up action, Government of India by 1972 imposed a total ban on Tiger hunting. The above government decision was further strengthened by the Indian Board of Wildlife's advisory action, with a request to all the States of the Union of India and the ban on killing of Tigers was imposed for 5 years at the initial stage.

1.1.2. Formation of Task Force:

The Prime Minister Shrimati Indira Gandhi on her personal interest desired that a group of specialists should study the exact position of tiger and plan how best the animal could be saved from extniction. This led to formation of task force consisting of 11 members of eminent position, having knowledge and experience on wildlife management in Indian

situation. On the basis of the report of the Task Force Committee—a Project was prepared by the Government of India—to save the Tiger. This is what is known now, as Project Tiger.

1.1.3. Identification of Project Areas:

The Project was prepared initially for 5 years and it was launched on April 1, 1973. At the beginning, the Project was taken up in 8 States, and subsequently Sunderbans (West Bengal) was added to the Project (Appendix I).

1.1.4. Priority Basis:

The selected areas under the Project were taken up as per the suggestion and best identified by the Task Force, considering all aspects of tiger eco-unit management, plus the future genepool maintenance of the species. All the typical tiger habitat conditions, with its natural system surroundings and vegetation cover, which can support the breeding population of the species were given priority for selection into the Project.

1.1.5. Objectives of the Project:

The objectives of the Project are to ensure maintenance of viable population of tiger in the Indian sub-continent for scientific, economic, aesthetic, cultural and ecological importance and to preserve for all times, areas of such biological importance as a national heritage for the benefit of education, knowledge, and enjoyment of the people.

1.1.6. Management Charter for Tiger Eco-Unit:

The Management Charter accepted that under no circumstances, Tiger population will be maintained on an artificial level by means like uncontrolled habitat modification, artificial feeding of the tiger or its prey, which may cause natural imbalance in tiger Eco-Unit, so far its fauna and flora are concerned.

1.1.7. Restriction for Consumptive Use of the Project Areas:

The rule of consumptive use of the Project area, specially for tourism recreation purpose, was considered secondary at least for few initial years. Commercial felling in the project area, collection of minor forest produce, including mining, excessive traffic and heavy domestic livestock grazing, were considered as detrimental and these are to be stopped—may be in phased out manner.

1.1.8. Priority of Biotope Preservation:

In any conflicting situation arising between conservation of the biotope and recreational use, the former should get priority over the latter whereas limited use of the reserves for scientific research and educative purpose, may be permitted.

2. SPECIAL FEATURES OF THE PROJECT:

2.1. Largest Land Area Protected for a Single Species:

The Project Tiger deals with the largest project area undertaken for a single species for its conservation in the world. (total area—its categorisation shown in Appendix II).

2.2. IUCN-WWF's involvement in the Project:

The idea of Project Tiger philosophy, and preparation of its management plan was done by Indian experts initially. But as it has generated active international interest in subsequent stages: international bodies like World Wildlife Fund, and the IUCN are involved in the "Operation Tiger" both for India, and other countries.

2.3. WWF's Contribution to the Project:

WWF has raised 1.8 million US dollars in its initial fund raising campaign of which 1 million dollar is being committed to the Project Tiger India, as additive financial help in kinds of equipments, expertise. services, training programme of managerial personnel, in India and abroad etc.

2.4. National Wildlife Conservation Focal Point:

The Project Tiger has become the national focal point, in the conservation movement of wildlife fauna and flora in India. The Project has not only created active interest amongst naturalists, conservationists, wildlifers and researchers, but it has also generated and imbibed conservation philosophy in the young generation.

2.5. International Symposium on Tiger 1979:

At the 5th year of the Project, an international symposium on tiger was held in New Delhi-India, in the year 1979 (February 22-24) with an objective view to pull out all available information on tiger. Besides 150 Indian participants, 32 foreign delegates, research workers and experts, naturalists, biologists took active part in technical sessions and 40 research papers were read and discussed.

3. Tiger habitat management strategies:

3 1. Background

3.1.1. Historic: Records of Tiger:

Tiger has been known to the Asians as early as 2500 B.C. from historic records of Indus Valley Civilization of Mohenjodaro.

3 1.2. Geographical Distribution of Tiger:

Before the 19th century tiger was known from Mount Ararat in Eastern Turkey to Caspian Sea, and to the sea of Okhosk in Russian Manchuria. In the eastern part, tiger occurred in Northern Afghanistan, Iran and USSR. In the northern area the tiger occurred in Korea to eastern part of China and in the Southeast Asia, including Hongkong, Singapore, Java, Sumatra—but not in Borneo.

3.1.3. Distribution of Tiger in the Indian Sub-Continent:

In the Indian Sub-Continent the Tiger was found almost all over the area, except in snowclad mountains of Himalayas, extreme western part of Thar desert and Sri Lanka.

The ever-green and semi-evergreen forests of eastern India, were supposed to be the real home of tigers. The entire Indo-Gangetic Plain, foothills of the Himalayas from east to west were famous Tiger Land of India.

3.1.4. Races of Tiger:

Eight races of tiger have been recognised, The Indian tiger (*Panthera tigris tigris*) the Type race Panthera occurs in the Sub-Continent—India, Nepal, Bhutan and Bangladesh). The other seven tiger subraces are—Siberian *(P.t. altaica)* found in USSR and Korea, the Caspian *(P.t. virgata)* found in Iran; the Chinese *(P.t. amonisis)*; the Indochinese *(P.t. corbetti)* found in Southern China, Vietnam, Malaysia, Cambodia, Thailand and Eastern Burma; the Javan tiger *(P.t. sondaica)* found in Java, is believed to be extinct. The Sumatran tiger *(P.t. sumatrae)* found in Sumatra and the Balinese tiger *(P.t. balica)* of Bali Islands are already extinct.

3.2. Census of Tigers:

3.2.1. Census base Figure of 1970:

Tiger estimate has always been a wild guess.E.P.Gee.s (1966) estimation of 40,000 tigers at the turn of the 19th century-appears to be without realistic basis. Whereas his estimates of 4,000 tigers in Indian forests in 1965 seems to be reasonable. Jim Corbett's (1955) estimate of 2000 tigers in India seems to be far from realistic. Whereas Sankhala's (1970) estimated number of 2,500 tigers in Indian jungles in the year 1970, is based on methodical counting by "Tiger Tracir" system, eliminating personal bias.

3.2.2. Footprints (Pugmarks) Collection of 1972:

The first methodical and systematic tiger census was conducted in India in 1972. The method of footprints (Pugmark) tracing, was adopted. The operation was conducted within shortest possible time throughout India between 22-28 April in the eastern part of the country and between 15-21 May in other parts of the country. The total estimated number of tigers was about 1800.

3.3. Causes of Depletion of Tigers:

3.3.1. Shrinkage of Habitat:

Tiger is a solitary animal, except for short courtship and mating period of 1-2 weeks, the adult male and female hardly come together. The female being confirmed of pregnancy-looks for a quiet and safe place where she can lodge her cubs undisturbed. The cubs are born with membrane on their eyes and are helpless. Gestation period is short (About 103-105 days) and the reproductive period a lmost synchronise (November-June) with the intensive forest working period in most of the forest areas in India. Cattle populations are free by grazing in

the forest along with other minor forest produce collection from the tiger habitat. All these varied biotic interferences sometimes become causative factors for the mother to leave the helpless cubs or part of the litter is neglected and dies of starvation.

3 4. Present Management Strategies for individual Tiger Eco-unit:

3.4.1. Status of the Project Areas Before Taking Up in the Project:

Considering representative habitat type, forest composition and cover, for potential tiger breeding purpose in its optimum natural condition—9 tiger eco-unity were selected in 9 different States of Union of India. These tiger eco-units are known as tiger reserves. Almost all the reserves area selected (except *Melghat* and *Similipal*) were already either declared National Parks, Wildlife Sanctuaries or Game Reserves. This means, all of them were under systematic management plan, under the respective state sector scheme, prior to bringing them under the Project.

3.4 2. Formulation of Project Guidelines:

With negotiations between government levels (States on the one hand and Union Government of India on the other) and even by personal discussions on meeting, at various stages of administrative and decision making levels, from the Prime Minister to the Chief Minister, it was resolved that while implementing the Project objectives, the guidelines laid down by the Government of India would get priority and the utmost possible attention would be kept in view, to protect the fauna and flora of the area under management plan, undisturbed.

3.4.3. Financial Relations Between the State and Centre:

The Project Tiger is a central plan scheme and it has been emphasised in the guidelines that the respective state Government are to maintain the flow of fund as it was doing for this area, prior to its being taken up in the project. Central sector contribution is an additive one.

3.4 4. First Phase—Habitat Cosolidation:

In the first phase the scheme gave priority on protection to tiger. its prey animals, and the vegetation of the area. It was felt necessary to cosolidate and rebuild the disturbed habitat of tiger and its prey animals. Utmost attention in all 9 tiger reserves was given to ameliorate all the negative factors in favour of building up potential breeding populations of the species.

3.4.5. Demarcation of Core and Buffer Area:

It was decided that an area not less than 300 sq km should be maintained as core area in the reserve for each tiger reserve and this area is to be kept absolutely free from anthropogenic interference, so that the breeding population of tiger can safely harbour the young

crops of the species. Total area under the Project today is 15,800 km including 4962 km of core area.

-3.4.6. Exception to 3.4.5.

Except Palamau (Bihar) and Ranthambhor (Rajasthan), all the Tiger Reserves satisfy necessary conditions so far core area is concerned but these two reserves, though otherwise suitable for maintaining as viable tiger population, have been accepted under the Project.

3.4.7. Sacrifice by Human Beings for Tiger

The core areas of the reserves are free from hunting, grazing, and forestry operation, and other biotic interferences of any sort. Even villages, located inside core area have been shifted from a number of reserves. All these are unique and have added marvellous exemplary land mark in the history of wildlife conservation movement in India.

3.4.8. Annual Plan of Operation for Each Reserve:

The Project objectives are being implemented as per envisaged guidelines and annual Eco-Unit management plans, problems of which have been identifid on local situation basis of the Areas. The object is to maintain optimum Population of tigers in each reserve. In no case, attempt should be made to maintain tiger population at an artificial level. In the documents of management, consideration is given on ecology of tiger. In the management charter—*the annual plan of operation* occupies an important role, keeping in view, both physical and financial targets. The annual plan of operation is prepared for each reserve, and got approved by the Central Government. The plan gives importance, while preparing it, on the experience gained during the previous years working.

3.4.9. Approval of Management Plan for Each Reserve for Five-Year Plan Period:

The management plans have been propared for all the tiger reserves, after discussions at various levels, both State and Central Governmenss and with the expert opinion of International bodies like IUCN, WWF, and the Steering Committee of the Project.

3.5. Administration of the Project:

3.5.1. Headquarters of the Project Tiger:

The project tiger's central administrative headquarters is situated at New Delhi, and it is a part of the Ministry of Agriculture, in the Forestry Division. The project functions under the direct supervision of the Inspector General of Forests, and is assisted by one Director, and one Dy. Director both being senior and experienced professional foresters of Indian Forest Service and are being picked up from the State Cadre on deputation basis. The duties of the headquarters are to watch on the progress of implementation of project objectives, in conformity with management plans and envisaged guidelines laid down by the Central Government. Other important functions of the headquarters organisation are to

maintain the flow of funds to the State Government. Supervision of certain field works, communication of administrative decisions, expertise opinions of WWF/IUCN, Communication of Steering Committee meeting proceedings to various state functionaries, scrutiny of annual plans of operation, review of expenditure allocation and release of funds, purchase of equipments, co-ordination between different reserves, international bodies, bilateral co-operation with neighbouring country's projects, collection, collation and dissemination of information on conservation of tiger and formulation of research schemes—are some of the varied important functions of the headquarters.

3.5.2. Project Tiger Steering Committee:

The Project is guided by a specially constituted advisory body known as steering committee. The committee consists of 5 official 3 non-official members, 2 special invitees of eminence, besides having a chairman and a vice-chairman. The committee normally meets twice a year and watches the progress of the project. The Stearing Committee's decision on certain issues like expertise services of WWF/IUCN officials, sending managerial or scientific personel for training abroad is important.

3.5.3. Field Administeration of each Reserve:

Each Tiger Reserve (total 11) is administered by a Field Director assisted by a Dy./Asstt. Director, both of them are professional foresters of sufficient knowledge and experiences on wildlife management and with scientific background. Besides this, each reserve is well equiped with sufficient trained personel of various grades who collect information on fauna and flora of the reserves—related to management practices necessary to follow up for implementing the project objectives.

3.5.4. Data Collection and Documentation:

Collection of field data on observation of tiger, its prey animals and vegetation changes etc., are some of the routine works of different levels of field workers of all tiger reserves. From all such information, some valuable scientific and technical papers have been published in various scientific journals in India, on tiger ecology, its behaviour and management problems of respective reserves.

3.5.5. Background Monitoring System

For the last 2 years, as a follow up action on background monitoring, suggested by Horril, Sykes and V.P. Lows after their visit to various tiger reserves in India, collection of information, on a regular punch card system, and laying out permanent stratified statistical plots as suggested, have been adopted by all the tiger reserves. All the reserves have created post of a Sr. Research Officer for fulfilling such special objectives. And most of the reserves in a short time would have the research personnel in position.

3.5.6. Central Data Bank:

From information system on punch card, the project headquarters have already been supplied with voluminous data on faunal and floral changes in the respective reserves, with reference to seasonal variation in the areas. In this way, a central data bank has been created and shortly some competent data handling personnel is to be appointed at the headquarters.

3.6 Annual Progress Report of Each Reserve:

3.6.1. Finance and Budget etc.:

Information on following major issues in reference to physical and financial targets are being mentioned.

3.6 2. Finance—allocation and expenditure both from central and state sector. Explanation for shortfalls, if any, of target is expected from the respective reserve administration.

3.6 3. Habitat Protection:

Wildlife and its habitat protection, exact nature of works taken up in the year, reason thereof for shortfall, if any, noted in the report.

3.6.4. Fire Protection Works:

Annual fire protection works—during fire season, exact nature of work done—e.g. how many km length have been maintained—intensity of damage if fire occurred during the period, to be shown.

3.6.5. Shifting of Villages:

Protection against grazing by domestic animals—exact measures taken up—including shifting of villages from the reserves areas—physical and financial target achieved, to be shown in the report.

3.6.6. Preventive Measure against Diseases:

Preventive measures against diseases of wild animals like rinderpest, foot and mouth diseases etc., exact nature of preventive measures, like innoculation given to local domestic cattle population, incidence of actual occurrence of epidemic diseases to wild herbivores—to be mentioned.

3.6.7. Development Activities:

Developmental activities like—construction of new buildings or maintenance of old buildings, construction of new roads and maintenance of existing roads, how many km of length built, constructed or maintained, to be shown exactly, in the report.

3.6.8. Wireless System for Communication:

Action—both physical and financial on wireless station, and mobile manpacked sets

maintained or taken up newly, to improve effective communication, should be mentioned in the annual report.

3.6.9. Water Storage for "Pinch Period":

Some of the reserves pass through acute water shortage periods known as "pinch period" —and it is necessary to take up ameliorating action of building water reserves—like water holes, construction wells, anicuts or check-dams to meet up the draught situation. To supplement natural salt deficiency to herbivores, artificial salt licks are given in most of the reserves regularly.

3.6.10. Annual Population Estimates (Carnivores):

An annual census operation specially for carnivore population estimate is done in all the reserves. The results, though being separately communicated to H.Q., are being mentioned in the annual report.

3.6.11. Cattle Lifting Cases by Tiger:

Number of cases of cattle lifted by tiger are recorded, and the amount of compensation paid to owners of domestic cattle killed by tiger, are also to be mentioned in the report.

3.6.12. Audiovisual Publicity Media for Motivation of Rural Community:

During the period under report, exact work of publicity done to motivate the local peoples, especially younger generation, to be mentioned, besides this, whether audiovisual publicity media, like radio, television, cinema projection, have been used, to be mentioned.

3.7. Research and Training:

3.7.1. Identification of New Research Area and Co-operation with Other Organisation:

Whether any new research scheme, on any particular project related to tiger ecology, behaviour or management problems have been taken up, either by any research staff member, or in collaboration with any individual scholar from any organisation like University or any institute, and the exact nature of problem being tackled to be mentioned in the report. Encouragement to research work by outsiders in all tiger reserves are given, with utmost co-operative spirit.

3.7.2. Professional Forester with Wildlife Management Knowledge:

Almost all the field and supervisory staff working in various capacities in the project are trained personnel, starting from Inspector General of Forests to Forest Guards. In the Indian situation forestry and wildlife always go together, each and every trained field forester is well equipped with basic wildlife knowledge and experience. Besides this, almost all the Field Directors by now had been sent to East African countries on study course for short duration on wildlife and game reserve management. Dy. Directors, Assistant Directors and range officers are frequently sent on special wildlife training course to Indian Forest College, Dehra Dun, for 6-10 months refresher's course. By these ways, India has already

built up sufficient personnel, of expertise in wildlife management. The tempo is to be continued for future too.

4. Achievements of the Project:

4.1. Direct and Indirect Results:

The project tiger by now, is over seven years old. The achievements of the Project can be considered on two points: *A. Direct results; B. Indirect impact* generated by the project philosophy.

4.1.1. Increase of Tiger Population (A):

Analysis from the estimated tiger population in the individual tiger reserves vis-a-vis 1972 (the base year count and 1977 count) is shown in the following tabular form:

Reserve	1972	1977	5 years	Growth (average per year in %)
Palamau	22	33	11	10.00
Corbett	44	74	30	13.18
Ranthambhore	14	22	8	11.42
Kanha	37	56	19	10.27
Melghat	27	57	30	22.22
Bandipur	10	26	16	32.00

Average annual population increase *16.51%*.

From the above figures it is seen that 16.51% average annual growth rate, which is fairly well for the tiger. Three reserves Manas, Similipal and Sunderbans—have not been considered—the obvious reason being that in these cases, initial population estimate was partial.

4.1.2. Increase of Prey Animals:

All the tiger reserve areas being under total protection for both fauna and flora, the prey population of tiger in every case, has shown considerable increase. This is evident from their dispersal in linear direction and by better utilisation of the vegetation cover.

4.1.3. Safety for Endangered Species:

Some threatened species like marsh crocodile (Superban T.R.), pigmy bog (Manas), swam deer (Kanha), rhinoceros (Manas), Black buck (Kanha) got total protection under the project—and this is a direct impact of the project in saving such valuable and rare species of animals.

4.1.4. Indian Wildlife Act 1972 for Rescue Operation:

During the beginning of the 1970's the position of Indian Tiger was precarious in a sense that, the Govt. of India had to impose total ban on tiger hunting with introduction of Indian

Wildlife Act, 1972, for the cause of the species survival. By adopting strict conservation measures, the position is somewhat better, today, not only for tiger but some other valuable species too. Tiger's cause, has directly or indirectly, become boon for others too.

4.2. Focal Point of Conservation Movement:

The project tiger conservation philosophy has become the main focal point for wildlife conservation movement in India. It has generated an unparalled impact not only amongst the general public, but amongst the younger generation also.

4.2.1. Building up of New Ecosystem:

Creation of 11 total conservation areas, in different forest types of India, has given the opportunity to build up new ecosystem centering tiger at its focal point. This is necessary not only for faunal preservation but for protection of original woodland of different ecosystems of the country.

4.2.2. Dedicated Wildlifers—A Gain for the Country:

The project tiger conservation philosophy, has given a fillip to build up, in its new dimension, a good lot of young and dedicated Wildlifers out of professional foresters. This is really a big indirect gain for the country.

4.2.3 Solution of Socio-political Problems:

By persuasive motivation, people have sacrificed their settlement lands from the reserve areas. This unique and unparallel sacrifice for the cause of tiger by comman man, has added new dimension to solve such socio-political problems.

4.2.4. Creation of New Jobs for Rural Folk:

The Project Tiger is a job oriented scheme. It has generated good lot of jobs, specially for rural folk. Over 90% of new jobs, for skilled, semi-skilled and unskilled, including daily labour have gone to rural nearby people, specially tribals and backward community people.

4.3 Research and Documentation:

4.3.1. Knowledge of Tiger Ecology, Behaviour, etc. Publication of Scientific Papers:

Our knowledge on tiger ecology, behaviour and its habitat management, were fragmentry, mostly based on unscientific legendary episodes, till the beginning of the project. Today, within a short period of about 7 years, we are equipped with voluminous informative datas based on actual observation records, taken in a systematic manner on ecology, behaviour, and management principles on tiger, its prey population and habitats. This could be further elaborated by mentioning that 34 valuable researh and technical papers have been presented in the International Symposium on Tiger in 1979, held in New Delhi (February 22-24, 1979). Beside this it is worth mentioning that 50 scientific, technical and popular articles have been published in various scientific, technical and other journals, in reference to tiger, its ecology, behaviour, and management etc., by various workers connected with the Project Tiger.

4.3.2. Publicity Campaign—Cause for Tigers Survival:

Number of short films on the project tiger, specially on different tiger reserves, like Kanha, Similipal, ("Kairi—Tigress") and their projection on almost all the India T.V. stations have created good impressions on the general public, specially to younger generations. Besides these, almost all the big regional radio stations have taken opportunity to broadcast opinion and views of eminent conservationists, naturalists, and wildlifers, connected with the project. Bringing out popular articles in local and regional English newspapers, along with pictorial representation, have become a common theme of some of the field officials. These methods of publicity campaign, have created very good impression about the philosophy of tiger conservation, and it is necessary to build up the opinion poll for the survival of the tiger.

5. Conclusion: "Tiger shall live":

Each and every living organism is a part and parcel of dynamic ecosystem. Tiger as a dynamic component of Nature has a vital role to play—to maintain nature's balance. As a predator tiger excercises its role to control herbivores, which in turn regulate vegetation growth of the ecosystem. Thus the total of the dynamic system is revolving in a cyclical order, distributing necessary amount of energy at each stage and level.

Man by his thoughtless and indiscriminate action, came into the way of the tiger's survival, one of the finest and most marvellous creatures of Nature was threatened with extinction, by man the paradoxial end-product of evolution. He tried to herald the death knell of the tiger. But fortunately, the saner section of men, took the cause of tiger to the judgment of intelligent one, where the tiger became victorious—with the birth of "*THE PROJECT TIGER*" ! What in the name of Project Tiger—man is doing, is nothing compared to the damages he has caused to the tiger.

By thoughtful action of man, the situation for tiger's survival is improving. And let us hope, and hope for the better days for tiger in Indian Jungles. Let us hope that our children would be able to enjoy the beauty of this magnificent cat in its natural surroundings—not merely in the natural history museums.

Our slogan for tiger's survival should be—"thou, shall not destroy, thou shall not kill the tiger. It has to fulfil the Master task, assigned to it."

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Portraits of Rare and Endangered Plants of India No.—I

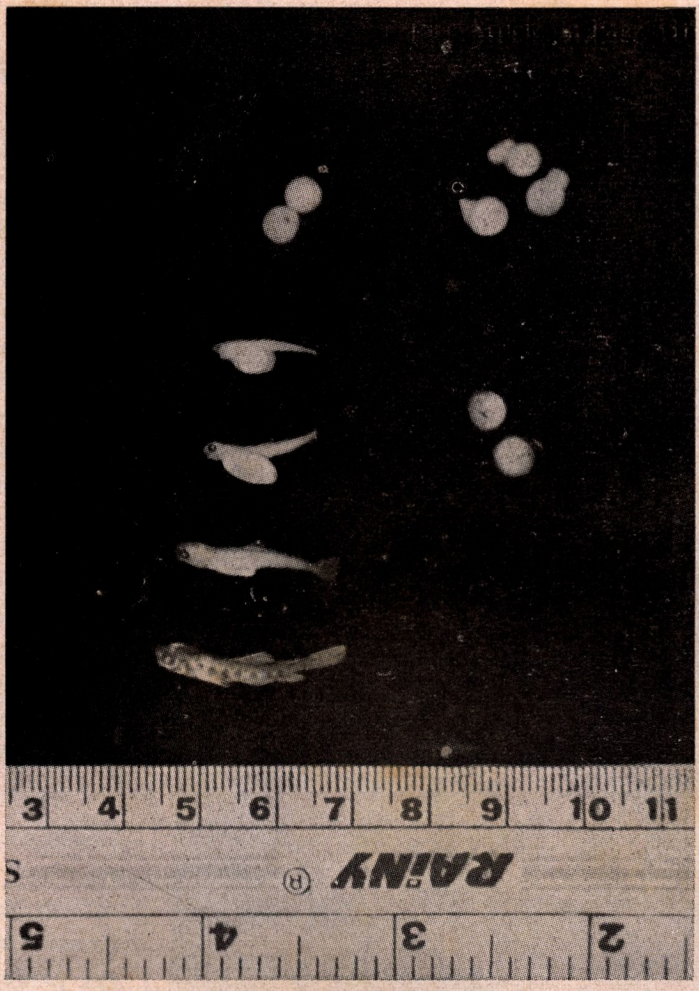
Papohipedilum villosum (Lindl.) Pfitz.
(*Orchidaceae*)

A terrestial herb, with leaves like garden amaryllis. Flower born on a villous scape. and subtended by a large hairy bract, is highly ornamental, 10-15 cm in diameter, with a large brownish yellow lip, resembling a lady's slipper.

The plant is extremely rare and occurs in Lusai hills of Mizoram and the adjacent areas of Moulemin, Tanasserim Burma.

The beauty and extreme singularity of the blossoms of the plant, joined to its great scarcity have occasioned it to be universally sought after by the gardeners, Botanists and others. Its existence is threatened due to indiscriminate collection.

SOM DEVA,
D.A.V. (P.G.) College,
Dehra Dun.



Photoplate I. Left hand series showing the development of trout. (*Salmo trutta fario*).

II. Right hand side (above) the trout eggs effected by soft egg disease and (below) the trout eggs with fungal infection.

(See Article on Page 33)

Propagation of Trout in a Garhwal Himalayan District—Uttarkashi

By

Ravindra Prasad and B.C. Pant

Department of Fisheries, Uttarkashi, Uttar Pradesh

Abstract

Propagation of brown trout (*Salmo trutta fario*) an exotic fish species (native of central and western Europe) and the renowned game fish of the world, has been studied in a Garhwal Himalayan district—Uttarkashi.

Introduction

The successful introduction of brown trout (*Salmo trutta fario*) in Himalayas (Jammu and Kashmir), dates back to 1900, when a consignment of eyed eggs was procured from Howeitonin in Scotland. From Jammu and Kashmir the fish species was introduced in Kumaon Himalayas for the first time in the year 1910, but it could not prove a success, probably due to high temperature, during summer months. In Himalayas the studies on the propagation of brown trout are on record (Jhingran 1975, Jhingran and Sehgal 1978, Sehgal 1972) from its western part, however, this aspect is lacking from Garhwal Himalayan region. To bridge this gap the propagation of brown trout in a Garhwal Himalayan district—Uttarkashi, has been studied.

Observations and Discussion

Brown trout (*Salmo trutta fario*) was introduced in Bhagirathi valley (district Uttarkashi) at Kaldayani trout hatchery for the first time in the year 1910 from Jammu and Kashmir.

Kaldayani trout hatchery located at an altitude of 1540 metres, at a distance of 14 km. from Uttarkashi along river Asiganga, experiences snowfall during winter and the hill-tops in the vicinity get covered with thick snow. Kaldayani trout hatchery was constructed (four tanks) by the then ruler of Tehri state in the year 1910.

The hatchery has recently been renovated and 16 additional new tanks, a silting tank, a working shade an office-cum-laboratory and residential buildings for staff have been constructed. All the tanks are provided with the facility of maintaining a constant flow of water.

Brown trout attain maturity on the onset of winter (last week of November or first week of December) when the water temperature at the hatchery is about 6°C.

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*First author is the principal author.

Temperature:—Temperature is one of the most important factor which affects every aspect of fish life. The water temperature recorded at the hatchery ranged from 2°C to 18°C (1979). The minimum and maximum water temperatures were recorded on 23rd January, 1979 and 24th June 1979 respectively. The amplitude of annual variation of temperature was 16°C.

Feed:—The brown trout breeders maintained at the hatchery are fed on artificial dry pelleted feed supplemented with locally available fresh fish. Fresh fish is deviscerated and half boiled before being given to the trout, to avoid whirling disease (Sehgal and Joshi, 1975). The feed is broadcast manually in the tanks and the intensity of feeding is regulated according to the water temperature at the hatchery.

The spawning period of brown trout at Patlikuhal, Chirgaon, Sangla, Barot, Laribal and Achabal hatcheries, in India is recorded from mid-December to end, mid-November to mid-December, mid-November to mid-December, December end to mid-January, mid-November to end, and December to January respectively. At Kaldayani trout hatchery the breeding operations start from the first week of December and last upto last week of February (1979).

The number of eggs obtained in the trout hatcheries of Kashmir, varied from 1234 to 1542 per kg. of body weight of the female fish. At Kaldayani trout hatchery the average number of eggs obtained were 1398 (1979-80) per kg. of body weight of the female fish.

During spawning period the breeders are examined for maturity and the mature fish are starved for one or two days prior to egg taking operations. The spawners are taken out of the ponds and the male and female fish are kept separately in two large tubs with water. The eggs from female fish are stripped in an enamel tray. The eggs are milted by dry (Russian) method and the two sex products are gently mixed with a bird's quill. After few minutes the surplus milt is washed out. A little water is added and the eggs are kept covered under an enamel tray for about an hour, for water hardening. After water hardening the eggs are counted and arranged in hatching trays, for incubation.

The wooden hatching trays with perforated zinc sheet or synthetic mesh base are commonly used at various hatcheries in India. However in peninsular India, the hatching trays with glass grills are used. At Kaldayani trout hatchery, for the incubation of trout eggs, the wooden hatching trays with perforated Zinc sheet or synthetic mesh base are used.

The hatching trays with the developing eggs are arranged in the hatching troughs. The two sides of the wooden frames of the hatching trays facing inlet and outlet of the hatching troughs are perforated by rectangular slits, protected by Zinc sieve or synthetic fibre mesh, so as, to facilitate the free movement of water.

At various trout hatcheries in India the hatching troughs made of wood (Mahili hatchery in Himachal Pradesh, and Avalanche hatchery in Tamil Nadu) or of unpainted

concrete (Laribal, Harwan, Patlikuhal, Chirgaon, and Sangla hatcheries in Himachal Pradesh; and Rajamally hatchery in Kerala state) are commonly used. At Kaldayani trout hatchery the hatching troughs made of wood are used.

The hatching troughs with the hatching trays and distributing trough are kept in ova house. A constant flow of clear cool aerated water is maintained in the ova house for incubation. The incubating water is passed through a silting tank and filtered to avoid any silt before taking into the ova house. As the trout eggs are susceptible to light, so, the door and windows of the ova house are kept closed for most of the time and the hatching trays arranged in hatching troughs are also covered under rectangular wooden planks. The incubating eggs in the hatching trays are not disturbed for first three days. After three days, the daily picking of dead eggs, which turn opaque, is done regularly with the help of tweezers, so as to avoid any spread of infection. During the course of incubation some of the eggs are sometimes found infected with fungus. To ward off the fungal infection, the incubating eggs are treated with Malachite green, in a concentration of 1:200,000 for few minutes. Apart from fungal infection the soft-egg disease and white spot disease are also encountered at the hatchery.

The incubation period of brown trout at Harwan, Laribal and Kulu hatcheries (snow cold water fed) is from 100 to 115 days and at Achabal, Barot and Chirgaon hatcheries (spring fed) varies from 65 to 73 days. At Kaldayani trout hatchery, which is river fed, the incubation period of brown trout ranges from 50 to 75 days (1979-80). The alevins are kept in hatching trays till the yolk sac is completely absorbed and the alevins turn into fry. The fry are transferred from the hatching trays to the initial feeding chambers. The fry are artificially fed on boiled egg yolk at the rate of 5% of their body weight four times a day. The boiled egg yolk is passed through a fine sieve at the time of giving to the trout. The inflow of water is reduced to the minimum for few minutes at the time of feeding. The fry are not fed during night. Brown trout fish seed is stocked in adjoining Asiganga river, a tributary of river Bhagirathi, as a result of which the brown trout has established itself in the upper reaches of Bhagirathi river system.

Himalayan region is endowed with certain high altitude lakes. In Kashmir Vishenar, Krishansar, Gangabal, Kansernag, Nankhul and Shishnag lakes (3400 to 5100 metres) are reported to be stocked with trout and Schizothoracinae, but their present status is not known (Sehgal 1972). In Uttar Pradesh, Deodital lake was stocked with brown trout. Deodital lake located at an altitude of 10,000 feet at a distance of about 38 km. from Uttarkashi, experiences heavy snowfall and becomes unaccessible during winter months. The surface water temperature of the lake ranges above and below 4°C during the year and limnologically it is a temperate lake. Brown trout has fully established in Deodital lake and different size groups of brown trout are represented in the population. The lake is full of brown trout and it provides a good tourist spot for trout fishing during summer months.

Rainbow trout:—The successful introduction of rainbow trout (*Salmo gairdneri*), an American salmonid, in Himalayas, dates back to 1912 when Mitchell got a consignment of eyed ova from Bristol water works from their headwaters at Blagdon, England. Rainbow trout which is more temperature tolerant, shows better growth and has shorter incubation period than brown trout was transplanted for the first time in Garhwal Himalayas at Kaldayani and Talwari trout hatcheries, in the year 1978, when 5000 eggs of the fish species were procured from Himachal Pradesh. The eyed eggs of rainbow trout hatched out successfully in their new environment. Due to excessive flood 638 fry of rainbow trout from Kaldayani trout hatchery escaped into adjoining Asiganga river in the year 1978. The breeding of rainbow trout which have grown to a maximum size of 24.5 cm. at the Kaldayani trout hatchery (October, 1980) are expected to breed in the year 1981, when they are expected to attain maturity.

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Corbett Memorial Essay Competition 1980

A NIGHT IN THE JUNGLE

VIKRAM CHANDRA

The night was still and quiet. It was around 5.30 p.m., and the sun had set half an hour earlier. The moon had not yet risen, and it was pitch dark. I crept among the trees on my way to my machan.

The night noises started. A peacock wailing on its way to its nest the crickets among the bushes, and the frogs in a distant lake. Some birds winged above me, their cries sounding like a factory siren signalling the end of the day.

I was a journalist, accredited to the National Geographic Magazine. I had been detailed to report on a night in an Indian forest. That was why I was now roaming about in the Bandipur National Park. I had with me a pair of binoculars which were equipped with a torch which would illuminate the scenery and animals, without throwing out a glare. I had left my other things on the machan earlier that day and was now roaming about the forest in the hope of seeing some animals.

A game ranger had told me that some elephants had been seen near the Bandipur-Madhumalai border. So I was now heading for that place. I wanted to see what the pachyderms did in the night. There was a sudden cracking noise to my left. I started, and looked up. A thrill of excitement ran down my spine. Just to my left within a 100 metres there loomed a placid giant chewing on some branches. Some more gigantic shapes were visible beyond him.

I was so enthralled, that I forgot who I was, where I was, but was absorbed by that pachyderm. Look at those tree-like legs, that versatile trunk, that stomach capable of digesting over 40 kg of food each day. Those feet which can crush a man's hand into pulp yet can step on a loved person's arm without leaving a mark. Those tiny eyes before that massive forehead, those shining tusks protruding from a smiling mouth. Why, he looked as if he was amused, as if he would burst into guffaws any moment. For an Indian elephant has a perennially happy expression upon his face. It was with great difficulty that I restrained myself from running upto that pachyderm and petting it!

The great beast turned and started to move. Then in the moonlight I got a full view of his magnificent tusks, the tusks that are both his friends and his worst enemy. For it is because of his tusks that man brutally massacres him, it is because of his tusks that he is hunted, it is because of his tusks that he is heading for extinction.

A cold flame of anger welled up in me against the poachers who could reduce this mighty beast to a stinking carcass lying in the mud. A kilo of ivory costs Rs. 3,000. No poacher can

resist the temptation of getting 50-60 kilos at one go ! However, the Government is, thankfully doing something about poachers. Ivory is no longer being used in handicrafts, thus greatly reducing its price. With luck, these beasts will have a long existence.

I set on the cold, grassy floor thinking about all this. I did not notice a baby cheetal coming up to me. By the time I finally became aware of it, it was only six feet away ! I stared at this trusting creature. Alas, it was too young to know that it must never do what it had done, that man was so vicious, cruel, and brutal a creature, that he would just as soon murder you, as look at you. A sudden movement of mine scared the tiny thing away.

I slowly rose and decided to go to my machan. The trees were towering on either side, looking like misshapen gargoyles. An owl was hooting rather cerily. I quickened my pace and finally reached my machan—a tower with a platform athwart it. It had been constructed by the forest rangers for a purpose similar to mine. As I was about to climb, my torch picked out some thing skulking in a hole in a nearby tree. I walked up, curious to see what it was.

It was a loris, a now extremely rare creature ! And to think I had nearly missed seeing it ! This poor creature is extremely man-like, but is less than a foot high. It is one of those few creatures who have a thumb opposite to the rest of its fingers, like a man. Its eyes are spell-binding and huge with a peculiar sadness in them, as if telling a long story of misery. Inhuman traders have been killing this creature because of the false rumour that its eyes are a potent love-charm. I refrained from touching the loris, as I knew it bites rather savagely for such a gentle looking creature !

Finally I returned to the machan and went up. I sat on the chair, and stared with expectant eyes at the forest, waiting for some animal to pass. There was a water-hole nearby where the animals would be going.

The bright, full moon shone down from a cloudless sky. The stars were twinkling. I could hear the baying of pariah dogs in some distant village. A troup of monkeys somewhere nearby chattered briefly and then again subsided into silence.

I suddenly felt hungry and decided to eat something out of my pack. I reached in and touched something cold and slimy. Surprised, with shock, I convulsively flung the pack away. The snake fell out of the pack where it had been sheltering and rolled to the floor. I went white with fear as I thought I recognised the snake. It was a krait—one of the deadliest snakes in the world. I picked up the chair and advanced towards the snake... I intended to crush it. As I prepared to strike, I shamefacedly realised what it really was. I was about to have committed the crime of thousands of people. The snake was no krait, it was a harm-

less wolf-snake, whose only crime in life was its close resemblance to a krait ! Who knew how many poor wolf-snakes had died because of this resemblance !

I again took my seat and resumed my vigil. When one is waiting for an animal to appear, all the bushes and shrubs get changed into animals, all shadows appear as potential creatures. Every small movement of a leaf is taken to be an advancing animal !

All of a sudden a kakar barked somewhere to the east. This noise was followed by a chorus of langurs. A big cat was on the move. All hell seemed to break loose there. I tried to imagine what must have happened. The tiger or leopard could have grabbed a langur or a peacock or attacked a kakar. I almost screamed with frustration as I was not able to see what was going on.

I looked at my watch. It was now 4.58 in the morning. Soon dawn would be breaking. Though it had been quite a successful night, I was disappointed at not having seen a tiger or a leopard. Thinking the night's adventures to be over, I got up and started to pack up my things. After that I leaned out over the back of the machan to wait for dawn.

Then suddenly I saw something of golden colour directly below the machan. My breath stopped and my heart stood still. It was a gorgeous tiger snoozing below my machan. It had probably been there throughout the night while I strolled around within a few yards of it, cursing my luck at not seeing a big cat. It had probably watched on while I examined the loris.

I stared at the tawny body with black stripes, those magnificent muscles and those powerful legs. Just then the tiger awoke, looked up at me and slowly, regally, strolled away. My night was made !

Vikram Chandra
(aged 13 years)
The Doon School

(This essay won the first prize in the Wild Life Essay Competition, 1980, Organised by Wild Life Preservation Society of India, Dehra Dun).

A Note on Tiger Census Technique based on Pugmark Tracings

BY

H.S. PANWAR

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Introduction

The pugmarks of one individual tiger are distinguishable from those of the other. Even where the broad lay out of different pugmarks appears similar, distinctions can be inferred through a minute examination. To enable such comparative examination accurate, tracings of the pugmarks are taken on a glass plate and later transferred to paper along with other data. When these tracings and the data are subjected to analytical comparison it is possible to identify precisely the individual tiger. This paper gives an account of the equipment, the tracing technique, and the method of analytical comparison of the tracings for identifying the individual tigers in a population as also in a methodology to work out a near accurate population figure in the surveyed area.

Equipment

Evolved by S.R. Choudhary, the "*Tiger Tracer*" is an extremely simple device to make accurate tracings of the pugmarks. It comprises of a colourless rectangular glass plate, of size : 20 cm × 25 cm × 3 mm. It has 4 holes near the corners and each of these carries a screw holding on to the plate by a nut and washer. Each screw has an additional fly nut.

A couple of rubber bands which can wrap round the plate, a free flowing pen (such as a fiber-micro-tip pen), some paper and a one metre steel tape, complete the assortment of the equipment.

The tracing technique:—Although the equipment is quite simple the rendering of accurate tracings is an exacting job and calls for a good understanding of the morphological characteristics of the paws of the tiger. One must look for the special features in the pugmark and trace them accurately. A lot of tracing practice and experience in analytical comparison by and by, enable a field worker to visualise the intricate differences that distinguish the pugmarks of one tiger from others. Following are the points of special significance :

(a) *The gait of the tiger:*—Like other quadrupeds, in a normal walk, a tiger's hind-paw of one side is placed at the same place where the front paw of the same side and earlier rested. This results is a partial or complete super-imposition of the fore pugmark by the hind pugmark. When the animal is moving faster, the rear foot over-shoots the fore pugmark and in such an event it will be possible to see both the pugmarks. In all cases, however,

the rear pugmarks can be seen intact and it is for this and another important reason (described later), that only the hind pugmarks are considered for the census work. In case of snper-imposed pugmarks, i.e., when the gait is normal, the stride of tiger is fairly constant and should invariably be measured and recorded on the tracing sheet itself in the field. This provides a good supporting evidence in making analytical comparisons.

(b) *The morphology of the paw*:—The front limbs of the predator are the chief means of attack on the prey. The forearms of the front limb are used in gripping and pulling down the prey and are accordingly built massively in both the sexes. The toes, claws and the pad are also accordingly stoutly built. The fore paw is therefore substantially bigger than the rear one in both the sexes and if a tracing of the pugmark is enclosed in a linear frame, such frame tends to be squarish in shape. However, if the tracings of the pugmarks of the hind paws are compared those of the male fit in a prominently squarish frame whereas those of the female in a retalively rectangular frame (See Fig. 1) Thus it is from the tracings of the rear pugmarks possible to determine the sex of an individual tiger. It is primarily for this important reason that the rear pugmarks are used in the tiger census work.

The paw is a supple organ and adjusts itself to the ground available for resting it. It can splay out and appear bigger on a slusby ground and look smaller and compact on a hard subsurface with a thin cover of dust or sand. Even in such situations, however, the characteristics of each pugmark remain unchanged and the difference, mainly in the size, can always be appreciated with reference to the habitat. On the other hand a small gravel or a small hole can cause the pugmark to twist or get splayed on one side. As far as possible, therefore, a perfectly normal rear pugmark should be selected for preparing the tracing. If no single pugmark is seen in perfect condition, the tracing should be made from the best one and this should be corrected in the field by placing the plate on one or two other pugmarks having those segments in good condition which were found distorted in the first.

Only 4 of the toes get an imprint alongwith the pad in the pugmark. The first toe in the rear is well above the pad and does not touch the ground when walking. The retractile claws also do not come out at the time of walk and therefore leave no imprint, except sometimes when the tiger is walking on a slushy ground. The pad is broader at the base and narrows down at the top but retains a near flat edge at the top. Of the 4 toes that get imprinted, two lie above the flat top edge of the pad and the remaining two lie one each alongside the two tapering sides a little lower than the middle toes. In the imprint, the upper edge of the pad leaves a straight line (or a near straight line) below the two middle toes whereas the tapering sides of the pad in the upper portion cave in a little near the extreme left and the extreme right toes. The lower part of the pad has large lobes on both sides. A third, much smaller lobe, lies in the middle part of the lower edge of the pad. (The

joints of these two side-lobes with the middle small lobe (are in the form of conically tapering valleys that leave the mark of two conically tapering ridges with well defined tips in the bottom line of the pugmark. While tracing the pugmarks, it is very important to correctly trace the flat edge of the top of the pad, the shape of the lobes and the two conical tips. It is also importat to correctly visualise the direction in which the two conical tips point. If the tracings incorporating these features are correctly made the different tracings of the pugmark of the same tiger walking on different soil types will remain still conducive to identifying that individual.

Precautions in tracing:—A well formed rear pugmark (either left or right) should be selected for tracing. The glass is plate placed above the pugmark and the fly nuts are so adjusted on the screws that the glass plate on pressing down comes close to the relief-edges of the pugmark but does not actually touch the edges. The Tracer should sit placing his knees on either side in such a way that he can bend over the plate and his eyes come vertically above it. The outlines of the pugmark should then be traced with a free flowing pen taking care to avoid the parallax error by moving the eyes with the pen so as to keep always the line of sight vertically above the segment under tracing.

The tracings on the glass plate are easily transferred to a sheet of paper. The plate overlaid with the sheet of paper (held fast to the plate with the help of two rubber-bands at the top and bottom) is held against light and the tracing copied on the paper taking care to avoid the parallax error which can be material if the glass plate is thick.

Caution with multiple tracks:—Tiger is an individualistic animal and associations between adults occur only in the courtship timer. Bringing up and training the cubs is entirely the responsibility of the mother and therefore the mother-cub associations are quite usual. Normally the male is intolerant of the cubs but when the cubs are grown up enough and the female is again likely to court, the male may be accepted in the group. When movement occurs in such associations the pattern of tracks is confusing and extreme care should be exercised in identifying the rear pugmarks of the different individuals.

Caution with superimposed tracks:—When tracing a rear pugmark which is superimposed on a fore pugmark, the outer peripheries of the bigger fore pugmark can also be seen at the margin. In such cases careful examination is neccessary to identify and trace the rear pugmark.

Distinction from Leopard Tracks:—It is difficult to distinguish a leopard pugmark from that of a young tiger cub. However, the largest leopard pugmark cannot be bigger than that of a 6 month old tiger cub. Confusion may arise while identifying the pugmarks of a young tiger cub below 6 months of age and that of a leopard. Here is it helpful to remember that such a young tiger cub will never move alone and will always be found to trail his/

her mother. Small pugmarks unaccompanied by bigger pugmarks can therefore safely be presumed to belong to a leopard.

Information to be recorded on the tracing sheet in the field:—The following information should be recorded in the field on the tracing sheet soon after tracing.

1. Date of tracing.
2. *Location* should be described say by specifying section of a road, foot-path, dry stream bed etc. so that approximate location of tracing point on a map may later be possible.
3. Direction of movement.
4. Surface requisites.
   (a) *Soil type* such as sandy, loamy or clayey, etc.
   (b) *Texture* fine, medium, coarse, gravel, etc.
   (c) *Moisture level* : dry, moist, wet, slushy.

5. *Freshness of the pugmark*:—Estimate the time when the tiger may have walked (such as previous night, one day or two days old, etc.). This helps in establishing reliability of the quality of pugmarks and also in distinguishing or co-relating apparently similar pugmarks traced the same day.

6. *Recording of deformity twist etc.*:—Some tigers may have an injury mark on the pad or one of its toes. Sometimes a toe or a part of it may be missing altogether from one of the paws leaving a sure means of identification. Some tigers may have a twist in one of the paws and this will be clearly seen in the pugmarks. Some tiger may also walk with a slight inclination in the pugmark to the direction of walk and this is seen consistantly in the pattern of pugmarks. All these peculiar features must be recorded.

The left and the right paws are the laterally inverted images of one another and it should not make any difference even if tracings are prepared from any one of these. However, it is in such cases that abnormalities or deformities in a particular paw become relevant and hence it is advantageous to have the traces of only the left or right rear pugmarks. As already mentioned earlier the deformed or abnormal pugmarks will in all cases have to be traced whether front or rear, left or right.

7. *Stride*:—This should be measured and recorded whenever the gait in normal.

8. *Sexes:*—This should be identified and recorded from the shape of the pugmark as described earlier.

9. The tracer should record his name and put his dated signatures.

Organisation of field work:—The work of tiger census should be carried out at such time of the year when there is highest probability of the tiger tracks being conveniently located.

In winters tigers shun the dew and prefer to walk on the roads during the night. It may also be convenient in other areas to locate the pugmarks near water-holes during the summer. This should best be decided by the local officials. It must be remembered that the higher the intensity of replications the greater is the reliability of results.

A suitable number of tracers who have an intimate knowledge of the area should be detailed early morning every day allotting them specified tract for survey for locating the tiger tracks. The trackers should be previously instructed to "preserve" the pugmarks. This can be done for example, on a road surface by cordoning off a small stretch of well defined pugmarks with boulders or sticks. Tracing work should be entrusted only to well trained and experienced hand having good mobility to reach different areas on receipt of information from the trackers.

The traces brought in should be carefully kept and even while the work is in progress, comparisons and co-relations should be attempted. As the petterns of identification emerge it will be advantageous to plot the individual tigers and the dates on a large scale map.

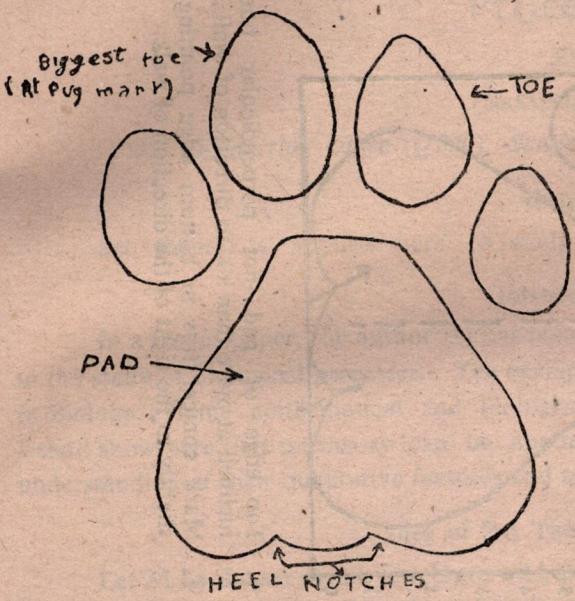
Analysis

This is done mainly by comparing the tracings. The date on which and the area where tracings were made are good means of initial classification. The size of the pugmark (after accounting for the likely variation due to surface type), the length and the inclination (to the direction of walk) of the flat top edge of the pad, the shape of the lobes, the placing of the two conical tips in the bottom edge and the direction in which they point are the main features which are individualistic and are a good means of identification. The deformities, inclination and twists are of course very important in such analytical comparisons. After a week or so of intensive survey and tracing a consistent pattern or pugmarks with respect to diferent areas starts becoming apparent.

Conclusion

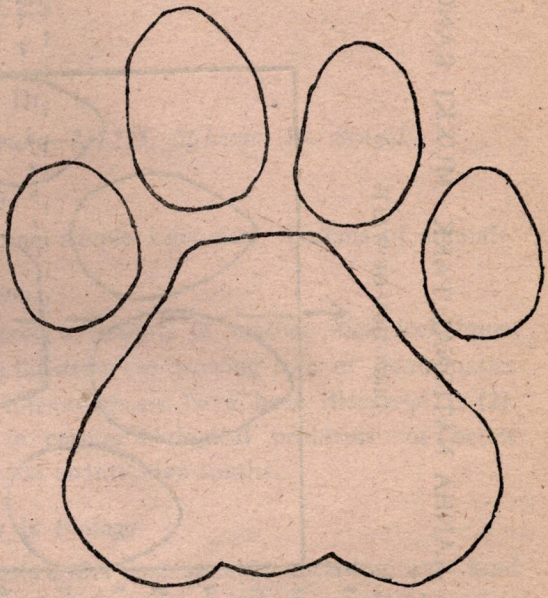
The method of tiger census based on tiger pugmark tracings can be fairly accurate but entails painstaking work in every step. From my own experience I can vouch the reliability of this method.

KANHA NATIONAL PARK
MUKKI RANGE



RT. Rr. Female—Minkur Nala, ½ km. Upstream of anicut. Very Fresh pugmark on wet compact sand. True size mark. Traced early morning. Movement of perhaps a few minutes ago. Heard sambar alarm calls from road. Came across tracks of tigress on investigation in nala bed not far from where sambar stood and later stampeded. Rear pugmark overshooting front one by a large margin, indicating fast stalking (Possible under cover of high nala bank). Right lobe bigger but left one abit dipping down. Dated 8th June, 1978.

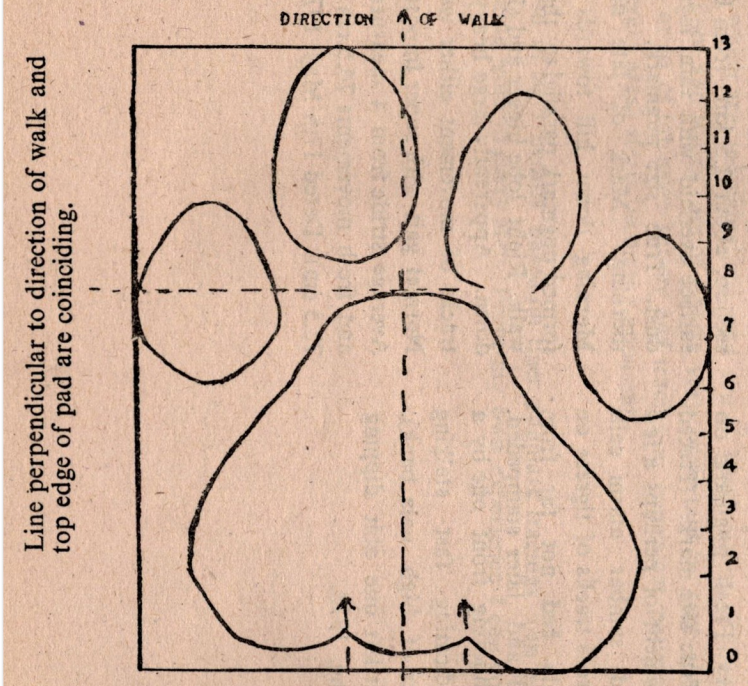
KANHA NATIONAL PARK
KANHA RANGE



RT. Rr. Male—Kisli-Kanha Road Ghat section, about 2.5 km. from Kanha. Hard surface overlaid with thin layer of dry fine dust. True size pugmark. Traced early morning. Mark of late night walking. Morning down hill towards kisli. Well formed pugmark parallel to the direction of walk. Right lobe bigger and slightly dipping down. Apparently large heavy animal. Old tracks of movement either way also seen. Normal gait with super imposed pugmarks. Average stride from 4 measurements of old and fresh movements 76.5 cm (Range 76 to 77.5 cm). Dated 17th May, 1978.

Fig. 1

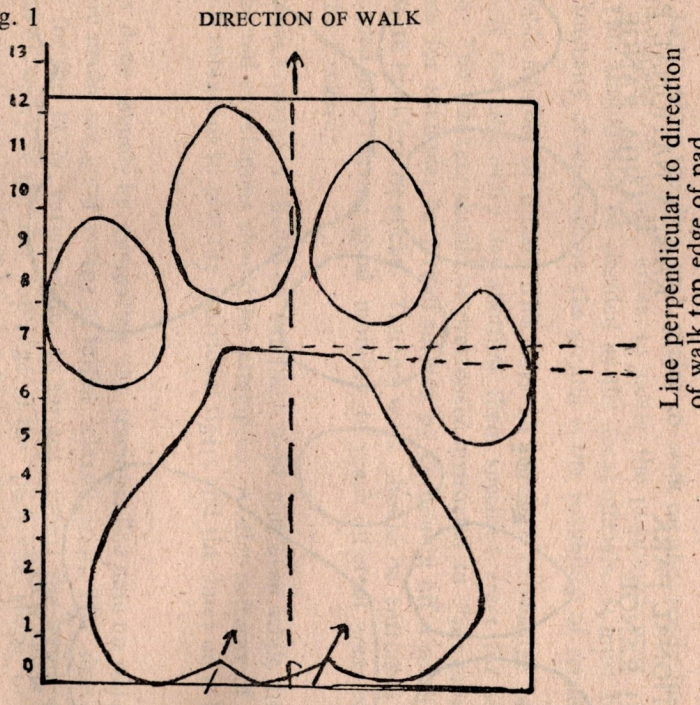
KANHA NATIONAL PARK—KANHA RANGE



Analytical Notes:

1. Top edge of pad perpendicular to direction of walk.
2. Mark conical tips in bottom edge pointing upwards parallel to the direction of walk.

KANHA NATIONAL PARK—MUKKI RANGE



1. Top edge of pad not perpendicular but inclined at more than 90° to direction of walk.
2. Mark conical tips in bottom edge pointing slightly to the right of the direction of walk.

Application of Set Theory to Study the Biological Processes

By

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Abstract

Set theory is applied here to study some simple biological systems of animals.

Introduction

In a recent paper, the author (1) has considered a number of mathematical techniques in the study of biological processes. The examples illustrate the growing role of mathematics in Biology. Some mathematical and biological inter-relations have been discussed in (2). I shall show here that set theory can be applied in certain biological problems for better understanding of their qualitative features and to yield quantitative results.

Idea of Set Theory in Biology

Let M be the set of all vertebrate wild animals and x be a variable meaning any kind of vertebrate i.e., $x \in M$. The class of herbivorous forms a subset say H i.e., $H \subset M$. Let P be the animals which do not eat plant materials. Then $\sim P$ means "x does not eat flesh". This corresponds to the complement $\overline{H}$ in M. Hence we have

$$H = \{ x \mid P \}, \quad \overline{H} = \{ x \mid \sim P \}; \text{ or, } \overline{H} = \{ x \mid x \in M, \; x \notin H \}.$$

Therefore, $H \cup \overline{H} = M$ i.e., $\overline{H} = M - H$. Consquently, $H \cap \overline{H} = \phi$.

If P : x 's set of all carnivorous (T)

Q : x is set of all herbivorous (H),

so we get

$$T \cap H = \left\{ x \mid P \wedge Q \right\}, \quad \text{or, } T \cup H = \left\{ x \mid P \vee Q \right\}.$$

We again define the sets

W : set of monkeys

Z : set of mammals

and P : x is a monkey

Q : x is a mammal.

If $Z \supset W$, $P \Rightarrow Q$

If P is true, Q is also true; if P is false, Q may be either true or false. If $x \in W$ then $x \in Z$. If $x \notin W$, then either $x \in Z$ or $x \notin Z$ and we write $P \Leftrightarrow Q$.

In all the cases, the commutative and associative laws are obeyed.

Application of the Theory

Nature consists of an infinite set of living organisms i.e., $N = \{ 1, 2, 3, \ldots\ldots\ldots, \infty \}$, of which there are two kingdoms : animals $A = \{ a_1, a_2 \ldots\ldots, a_n \}$, plants $B = \{ b_1, b_2, \ldots\ldots\ldots, b_n \}$, A and B are two subsets of the universnl set N ($A \subset N$, $B \subset N$, $A \notin B$) such that $A \cup B = N$, $A \cap B = \{ x \mid x \in A$ and $x \in B \} = \phi$.

The sets of animals and plants are divided into subsets, each representing a stage in the evolution of a species. In course of evolution, each class is divided into orders, each order into families, each family into genera, and each genus into species. Further sub-division namely, suborders and super-families are also noted. Again, $A = IUV$, where I stands for invertebrates and V for vertebrates. The seashore is the transitional zone between the marine and the terrestrial environment. The well-known classes of terrestrial vertebrates are Amphibia (frogs, toads, etc.), Reptilia (snakes, lizards, etc.), Aves (birds) and Mammalia ("warm-blooded" animals with hair, mammary glands etc.).

To study the forest eco-system, we consider that the set of living organisms (L) consists of (i) producer (C_1), (ii) first kind of eater such as monkey, deer, squirrel, various birds, etc. (C_2), (iii) second kind of eater such as wolf, fox, snakes, etc. (C_3) and the highest kind of eater such as tiger, lion, eagle-like birds (C_4) i.e., $L = C_1 \cup C_2 \cup C_3 \cup C_4$.

The feeding habits of some common birds, fishes or wild animals can be represented by a Venn diagram (Fig. 1).

P is the set of plant eating species (natural vegetative character), G is the set of flesh eating and K is the set of omnivorous species. If $P = \{ a, b, c, d, e, f, g, h \}$, $G = \{ d, e, f, g, h \}$, therefore $P \cap G = \{ d, e, f, g, h \} = K$.

Some of the common omnivorous species are song thrush, house sparrow, blackbird, cats, bears, etc.

Let us now consider that the set of quadrupeds Q contains the elements:

Plant-eating (A), Horned (B), Hornless (C) i.e., $Q = AU\ BU\ C$. The set of plant-eaters P is made up of the sets of A, B, C and also the element {p}, which is an element of the set F but should also be included in P, the set of plant-eaters. The set of plant-eaters $P = AU\ BU\ CU\ \{ p \}$, where $\{ p \}$ is a unit set.

Fig. 1.

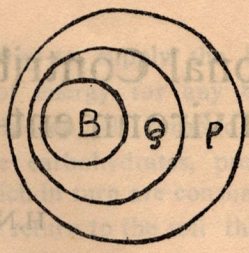

Fig. 3.

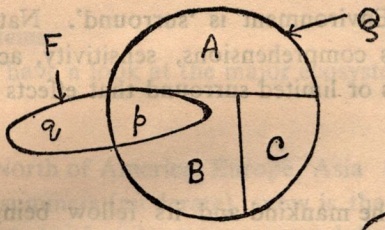

Fig. 2.

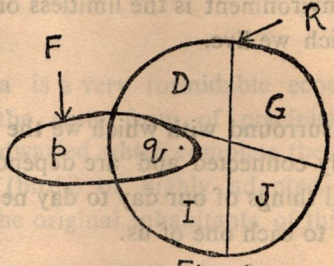

Fig. 4

$\{p\} \subset P$, $\{p\} \subset F$ but $F \not\subset P$, $F = \{p, q\}$, $\{p\} \not\subset Q$, $Q \subset P$.

This shows that $\{p\}$ is not a quadruped but it is a plant-eater.

The relationship between Horned mammals (B) which are quadrupeds (Q) and which are plant-eaters (P) is shown in Fig. 3.

The set of flesh-eaters (R) is made up of the sets of flesh-eating mammals (D), the stem reptiles (G) flying reptiles (I), eagle-like birds (J) together with q an element of the set of (F). Thus $R = DU\ GU\ IU\ JU\ \{q\}$, $F \not\subset R$, $p \in F$.

As a Venn diagram, this is illustrated in Fig. 4.

Remark

The theory can be applied to other biological systems relating to ecology or physiology, natural history and classification of plant kingdom, etc.

Acknowledgement

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Non Traditional Contributions of Forest Ecosystems to The Environment—An Economic Appraisal

BY

H.N. MATHUR*

The Environment

The dictionary meaning of the word 'Environment' is 'surround'. Naturally the word has dimensions entirely depending upon ones comprehensions, sensitivity, activity etc. Very broadly speaking environment is the limitless or limited surround that effects the functioning of the world in which we live.

The Biosphere

The part of surround with which we the mankind and its fellow beings—animals and plants are intimately connected and are dependent upon is called the biosphere**. From this biosphere we get all things of our day to day needs, hence the well being of the biosphere is of vital importance to each one of us.

The Ecosystem

The biosphere on which we live, breathe, eat and die is made up of a number of ecosystems ***. Ecosystems are independent operating systems on one hand but also closely interlinked with other ecosystems. Ecosystems have no defined physical limits but each ecosystem is a functional unit. For example a small agricultural field, a pasture or grazing land, a garden or public park, a class room, a school, a city, a forest, a forest type, a lake or a pond all constitute an ecosystem. It is a system where the biotic and abiotic components are in equilibrium with each other and influence each other greatly.

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A talk delivered on 5th June 1980 at the World Environment Day Celebrations, organised by Wild Life Preservation Society of India, Dehra Dun.

** BIOSPHERE : Biosphere is defined as the thin layer of soil, rock, water and air that surrounds the planet earth alongwith living organisms for which it provides support and which modify it in direction that either enhance or lessen its life support capacity. (Dasman—Environmental Conservation, 4th Edition, 1976).

*** ECOSYSTEMS : Ecosystems are subdivisions of the biosphere. They consist of communities of plants, animals and micro-organisms alongwith air, water, soil or other substrata that support them. They may be large or small, the term is flexible (Dasman—Environmental Conservation, 4th Edition, 1976).

For each community to exist it must have energy to supply the life processes of the organisms that compose it. The principal source of energy for any biotic community is sunlight. Plants trap sunlight with the help of chlorophyll, carbondioxide and water to produce glucose and later complex compounds like carbohydrates, proteins, vitamins etc. These foods are consumed by herbivorus animals which in turn are consumed by carnivorous animals and die their own death and ultimately these return to the soil through death, decay to be utilised again by plants.

The Major Ecosystems

Let us now have a look at the major ecosystems that constitute our environment.

The Tundra

In the far North of America, Europe, Asia is a very formidable ecosystem with long winters and short summers (moderate), snow is the main form of precipitation. These are cold deserts. Plants are few, long growing and dwarfed which complete their life cycle in the limited summer. Animals are either migratory (birds) or highly adapted like Polar Bear, Arctic Fox, Caribou, Musk fox, Eskimos were the original inhabitants of this ecosystem.

The Boreal Forests

These forests exist South of the Tundra region beyond the perma forest areas occupying parts of Canada and United States of America, Asia, Europe, (Russia, Siberia). It is characterised by evergreen coniferous forest mostly spruce and fir. It has higher precipitation and higher temperature. Podsolic soils with acidic reaction are characteristic of the ecosystem but not very suitable for general agriculture. The animal life is similar to tundra migratory birds. Permanent animals include moose, woodland caribou, lynx, fisher, wolverine, snow shoe hares etc. The region is sparsely populated.

Deciduous Forest

These consist of broad leaved trees which become leafless once in a year and occupy parts of America, Central Europe, Eastern Asia. The important tree species are Oaks, Maple, Hickory, Beach, Sal, Teak, Sisham etc. It has relatively heavy rainfall in the summer and warm summer, cold to cool winter with gradual absence of snow as we move Southward towards the equator.

There is lot of biological activity resulting in luxuriant growth of vegetation, abundant leaf and litter fall, decomposition and release of nutrients and consequently rich soils exceedingly suitable for agriculture and the seat of greatest human activity and interference. This ecosystem also supports a large animal population resident in the area including both vertibrates as well as invertibrates. Various types of deer, sambhar, cheetal are plentiful.

Grasslands

These lie between forest and desert and with climates in between the two. The region has relatively low and erratic rainfall, summers are warm, winters are cool. Vegetation is mainly grasses tall ones near the forest and short ones dominate in dry areas. Soils are rich and fertile with neutral reaction. Animal life is usually herds of grazing animals and those dependent on them for food (carnivorous) and man.

Deserts

Low rainfall, high temperature, strong winds, space or no vegetation characterise this type. These are areas which receive less than 10″ or 25 cms of rainfall. Plants and animals that inhabit these regions have specially adopted to the conditions. Natural deserts occupy much of Central and Western Australia, extend in a broad belt from Sahara to India via Arabia. Similar ones exist in North and South America, Africa.

Mediterranean

Moderate winter, moderate rainfall, warm and dry summers characterise this type. It is met with the North America (California), Chile, South Australia, South Africa, parts of Europe, Asia and Africa. Most of the Eucalyptus forests of Australia fall in this type. Chaparral in United States of America and Oaks are also included in this group.

Temperate Rain Forests

Includes both conifers as well as broad leaved forests. Examples are the great red woods of North America. This is associated with high rainfall well distributed throughout the year, mild temperatures which favours development of usually all, dense luxuriant forest. Apart from West Coast of America this type is found in Southern Chilie, South Island of New Zealand and South Australia.

Tropical Rain Forests

Year round rainfall, the soils never dry out and temperatures are always favourable for high plant and animal activity resulting in the most luxuriant plant growth and abundance of variety. It supports the epiphytes like orchids and ferns which never touch the soil. There are many canopies in the forest but little or no under growth or ground cover because of lack of sunlight reaching the forest floor. It has very few ground dwelling animals but a good number of arboreal ones like birds, mammals, insects etc.

The soils develop under the canopy of trees and are rich in organic matter and plant nutrients but if cleared of trees there is rapid oxidation and leaching of minerals, therefore these need very careful handling. This ecosystem is under the greatest danger/pressure from the land hungry people and those industrialists interested in economic exploitation of the land, water and vegetation resources.

Savanna

It is a vegetation consisting of scattered trees and shrubs or groves and thickets in an otherwise grass covered region. These occur along the boundary of forest and grassland where local differences in climate or soil favour an interspersion of vegetation. Animals and people prefer such areas, hence these have been created by using fires and grazing as tools. A large number of animals ranging from deer to elephants and many carnivores inhabit these.

Aquatic Ecosystem

70% of the total world area is occupied by this ecosystem. These could be further classified into marine ecosystems and inland ecosystems. These ecosystems are coming in for more and more attention with the saturation of the terrestrial ecosystems and the limited opportunities the terrestrial ecosystems offer for further exploitation.

The Indian Ecosystems

Having considered the major ecosystems of the world let me introduce you to the major ecosystems of our own country. These are given in Table 1.

All the basic needs of the animal/plant life is derived from the biosphere through the use of natural resources. These natural resources are of two basic types:

Natural Resources

Biotic (Renewable Resources)	Abiotic
Plants	Energy
a) Domesticated (Agriculture)	Light
	Temperature
	Inonic radiations
b) Wild (Forest, pasture etc.)	Atmosphere (air), Inexhaustible and easily polluted.
Animals	Water—Renewable exhnustable and easily polluted.
a) Domesticated	Soil—Non renewable
b) Wild	Geology—Non renewable
	Fire
	Gravity
	Pressure
	Sound

Table 1

Major ecosystems of India

	Name of Ecosystem	Important Tree Species	Remarks
1.	Tropical wet evergreens	Dipterocarps, Phobe's, Mesua, Poeciloneuron, tree, ferns and orchids.	Distributed in Assam, Kerala and other high rainfall area. 'Silent Valley' is located on these forests.
2.	Tropical semi-evergreen	-do-	West Coast, Assam.
3.	Tropical moist deciduous	Sal, Teak forests are the important tree species.	The most controversial introduction of Eucalyptus and Tropical Pines is drawing attention. Area mostly encroached upon by Agriculture, very heavily populated.
4.	Tropical dry deciduous	Sisham, Sandal, dry Sal and teak, Babul	-do-
5.	Tropical Thorn	Babul (*Acacia nilotica*) Euphorbia	-do-
6.	Tropical dry evergreen	(*Tamarindus indica*), Imlim, Neem, Siris.	-do-
7.	Tropical litteral and swamp.	Mangrove sps., Hertaria, Rhizophore etc.	Sundarban areas.
8.	Subtropical broad leaved hill forests	Eugenia, Rosewood, Schima.	It is subjected to large-scale encroachment for hill agriculture. Conversion to Cryptomeria man-made forests in Darjeeling area.
9.	Subtropical Pine	Chir, Banj, (Oak)	Destruction by grazing, fire and encroachment by agriculture and/horticulture.
10.	Montane wet temperate	Oak, *Michelia*, Acer	Highly erodable when disturbed.
11.	Subtropical evergreen	Olive, *Acacia modesta*	
12.	Himalayan moist temperate	Fir, Spruce, Deodar.	Encroachment for agriculture and horticulture.
13.	Himalayan dry temperate	Tilgoza	
14.	Alpine & Subalpine	Junipers, Rhododendrons.	The true climax grassland now threatened by over grazing.

There are no hard and well defined lines which can be drawn to define these but the nomenclature itself explains as to the basic nature of the resources.

The constitutents of the biosphere and the natural resources are in constant interaction with each other, these get modified and inturn modify other resources. The interaction is illustrated in the following figure (Appended Page 61).

Note:—All the factors react with each other.

The population of the world has increased from 545 million in 1650 to 3632 million in 1970 and expected to be 6130 million in 2000 (United Nations Medium Estimates). This increase itself is sufficient to put tremendous pressure on the natural resources of the ecosystems for production of more food, more shelter, more fuel and more energy, more need of more raw material and demand ever increasing facilities and conveniances, to have a 'life of quality'. The meaning of life of quality is vastly different for different people. To achieve this, one modifies the ecosystem by introducing new elements, technologies, plants, animals brought from within or outside the ecosystem and vice-versa.

The developments like establishment of industry extended and improved communications, enlarged cultivation, hasten up construction, release of foreign matter or increased percentage of pollutants into the system, which cause harm to the inhabitants. This process of pollution has brought about drastic changes in the ecosystem.

The Technosphere

The part of the biosphere which can be effected by present day technology is called the technosphere. It is this part of our environment which is very severely effected by the greed of the mankind and the careless disregard to the consequences of their activities. These activities pollute the three important resources of air, water and land. Air and water combine to cause havoc to the land resources if the land resources are improperly used. Forests play a very important role in protecting the land against wind and water resources and by producing useful products.

Extent of Erosion in India

It is a two way sword—it hurts the land and people where it takes place so also the land and people where it gets deposited. In our context the following figures speak about the extent of this problem.

1.	Total geographical area of India	328 million ha.
2.	Total area subject to erosion by wind and water	150 „
3.	Area at critical stage of deterioration due to erosion	69 „
4.	Area subject to wind erosion	32 „
5.	Area effected by gully erosion and ravines	4 „
6.	Area effected by shifting cultivation	3 „
7.	Area under rainfed farming (non-paddy)	70 „

SOURCE : Report of National Commission on Agriculture.

Good land husbandry can reduce erosion to very long levels. Forests play a very important role in controlling erosion. Forests apart from controlling erosion provide many other important services very useful and essential to the country which are rarely noticed and quantified in material and monetary terms. Since this quantification is difficult it has been very frustrating for Conservationists and Foresters to convince the administrators, politicians and public for higher investment and concern for forest and environmental conservation. An effort has been made in the following paragraphs to quantify intengible benefits provided by forest and forest like vegetation to the people and to the environment in which we live.

Let us examine the possible products and services rendered by a forest or natural vegetation consisting of trees/shrubs/grasses/herbs/climbers/animals, land, water and air etc.

Prof. Das, T.M. (1980) in his paper The Value of trees, Silvan *(EFRC Magazine), has made the following calculations to put a price tag on various products/services rendered by a fifty year old tree with an average weight of 50 tonnes.

Table 2.

The value of benefits derived from a medium sized tree of 50 tonnes weight during its life span of 50 years, value of timber, fruits and flowers have not been computed.

1.	Production of Oxygen	Rs. 250,000 00
2.	Conservation to animal protein	,, 20,000.00
3.	Controlling of soil erosion and soil fertility	,, 250,000.00
4.	Recycling of water and controlling of humidity	,, 300,000.00
5.	Sheltering of birds, squirrels, insects and plants	,, 250,000.00
6.	Controlling of air pollution	,, 500,000.00
	Total	Rs. 15,70,000.00

To quote Prof. Das, a medium sized tree as per current average market rate would hardly fetch, on an average more than Rs. 5,000/- which is only .3% of the 'real value' of the tree. But at the same time if a tree is cut down the damage is rather permanent in nature and cannot be recovered immediately, not withstanding how much input of money, or labour is made on the spot. Moreover, it is a loss to the whole community and not a single person.

*Eastern Forest Rangers College Magazine (1980) (PP. 23-25).

Trees are the 'source and sink' in nature. They absorb unwanted gases, noise, dust etc. and produce the much needed rather essential items. Some of the benefits obtained from the trees are explained below:

Photosynthesis is the biological process by which green plants utilise the energy of sun-light to convert carbon-di-oxide and water into carbohydrates and other organic compounds.

$$6\ CO_2 + 12\ H_2O \xrightarrow[\text{Light}]{\text{Chlorophyll}} 6O_2 + C_6H_{12}O_6 + 6H_2O$$

During this process six molecules of oxygen are released and six molecules of carbohydrates (glucose) are produced. Some amount of oxygen produced is also used by the tree in respiration. However, according to Das (1980) the rate of oxygen production is far greater than its rate of consumption, so the balance is being stored up in the atmosphere. The total amount of oxygen production by a 50 tonne medium size tree is at least 1 tonne per year, the present market price of this amount of oxygen is Rs. 5,000/- (Rs. 5/- per kg.). If the tree lives for 50 years, the total value of its oxygen production would be amounting to Rs. 250,000.00.

Accordingly if we calculate the average oxygen production of different types of forests (Table III and IV) it is seen that tropical forests produce the highest amount worth approximate Rs. 22.5 lakh, subtropical forests Rs. 20.50 lakh and temperate forests Rs. 15.00 lakh per ha per year respectively. Recently Dr. Richard Baker (August, 1980) founder of the 'Man of trees' movement said it took 16 trees to produce enough oxygen for one person. If trees were destroyed particularly in cities like Bombay, people would choke to death for lack of oxygen.

During the same process of photosynthesis trees absorb 6 molecules of carbon-di-oxide from the atmosphere and maintain the balance of carbon-di-oxide in the atmosphere. Higher concentration of CO_2 are harmful to animal and human health on earth.

Besides CO_2 many other toxic gases are absorbed by tree leaves. Recently it has been reported that gases like sulphur-di-oxide are absorbed by the leaves of some tree species. Tree leaves are capable of absorbing noise and dust particles, thus playing an important role in reducing the problems of noise and air pollution, air pollution is controlled by presence of trees, emphasis should be laid on research projects to identify suitable tree species and to quantify their role in air and noise pollution control.

Birds, squirrels and a large number of insects and other lower organisms get shelter on trees. Trees and forests are essential for preserving the wildlife flora and fauna of any region.

Trees absorb many toxic gases, and thus control air pollution. Recently Mrs. Padma Waheed, (1980) in her writeup in Indian Express, has said that mango trees can absorb sulphur-di-oxide and therefore these should be planted around the Mathura Refinery and on the road from Mathura to Agra. These forests and the tree lined boulevards will act as little pockets of oxygen producing centres for human life new getting suffocated due to uncontrolled industrial and other types of pollution in poverty stricken India and also as sinks for toxic gases like sulphur-di-oxide.

Keeping the information given by Prof. Das, as the base, efforts have heen made to work out these values for various types of forests and of monocultures of different species on per hectare basis:

Table 3

Value of benefits derived from different forest types (Rs. in lakhs/ha)

	Tropical Forest	Sub-tropical decidious	Temperate
1. Production of oxygen	22.50	20.50	15.00
2. Conservation of animal protein	1.80	1.64	1.20
3. Controlling of soil erosion and soil fertility	22.50	20.50	15.00
4. Recycling of water and controlling of humidity	27.00	24.60	18.00
5. Sheltering of birds, squirrels, insects and plants	22.50	20.50	15.00
**6. Controlling of air pollution	45.00	41.00	30.00
TOTAL	141.30	126.74	94.20
*7. Biomass (Tonnes/ha basis of the above calculations)	450.00	410.00	300.00

**Applicable if air pollution exists in the area.

*SOURCE : Kaul, O.N. (1973) Organic productivity and nutrient cycling in forest ecosystems, Forestry Conference, held at F.R.I., Dehra Dun.

Table 4

Non wood valuation of plantation at New Forest, Dehra Dun (Rs. in lakhs/ha)

	Pinus roxburghii	Shorea robusta	Tectona grandis
1. Production of oxygen	3.42	10.96	4.32
2. Conservation of animal protein	0.27	0.87	0.34
3. Controlling of soil erosion and soil fertility	3.42	10.96	4.32
4. Recycling of water and controlling of humidity	4.11	13.16	5.19
5. Sheltering of birds, squirrels, insects and plants	3.42	10.96	4.32
**6. Controlling of air pollution	6.85	21.93	8.64
Total	21.49	68.84	27.13
7. Age in years	30	35	33
8. Biomass (Tonnes/ha)	68.51	219.38	86.53

**Applicable if air pollution exists in that area.

Besides all the above indirect benefits derived from the trees they provide timber, fuel, forage, fibres, many minor products which are essential e.g. gums, resins, fruits, drugs, species etc. The direct and material benefits are small as compared to the indirect benefits and services rendered.

Forests help in dissipating the energy of falling rain drops and thus reducing the ability of rainfall, to cause erosion. At the same time tree cover is important in conservation of soil moisture, groundwater recharge.

The nutrients released from the trees enrich the runoff water, vegetation and water cycle are correlated. Henry Blanford FRS, Erstwhile Meteorological Reporter to the Government of India, has said that vegetation and consequent evaporation affects even local rainfall. The most important path for water which falls on the land is that of infiltration into the soil. In a forest soil we found innumerable hallows caused by the decaying roots of trees and by

geological forces and these acquifers get filled up by water during rains, and to fill these it is necessary that the water which falls on the land does not run away quickly. This can be achieved only when ground is protected well by trees, shrubs etc.

Precipitation received over forest area

The forests in our country receive an estimated 92 million ha m of precipitation every year. This water is then processed through the 'forest' and delivered into the drainage system as well as deposited in the groundwater reservoir or stored temporarily in the soil/rock profile below the forest floor.

Soil moisture storage

It has been estimated that the forest soils can store 25 million ha metres or 25×10^{10} cubic metre of water. An earth dam of an equal capacity will cost the equivalent of Rs. 1250000 million. On a conservative estimate it costs Rs. 5/- (Mathur, H.N. (1980) Water the vital forest Produce—a Plea for its management, paper presented at the II Forestry Conference, held at F.R.I. and Colleges, Dehra Dun, to store one cubic metre of water in an earthen dam. The soil moisture storage per ha of real forest area is equivalent to an earth dam costing Rs. 16667/-.

Moderating influence of forest on dry weather flow

Out of the 92 million ha m of precipitation received at least 35% (26 million ha metres) go as surface runoff. About half of this i.e. 18% is subjected to the moderating effect of forest, the other half flowing away as uncontrolled flood flows. As the moderating effect is spread all over the year, the beneficial effect is essentially only during dry weather flow for six months i.e. about 9% of the flow which comes to about 8 million ha metres, which could not have been available but for the presence of forest. Calculating on the basis of Rs. 5/- per cubic metre for stored water cost of this amount of stored water comes to Rs. $8 \times 10^{10} \times 5 = 40 \times 10^{10}$ Rupees. This is only the moderating effect.

To this we can add the reduction in flood drainage because of corresponding reduction in flood levels—with the same yardstick it would also add another Rs. 40×10^{10} to the tangible benefits of the forests. It has been experimentally studied that peak rates or flood discharges from small watersheds could be cut down as much as 60% by good forest management (Mathur, H.N. (1976) The effect of clearfelling and reafforestation on runoff and peak rates in small watersheds, Ind. Journal of Forestry 102(4) 219).

Employment generation

It has been estimated (Varmah, J.C. (1978) Forestry for employment promotion and over view of Research, paper presented at the 8th World Forestry Congress, Jakarta) that there exists an employment potential of 556.5 million man days for collection, processing,

marketing etc. of minor forest produce and an actual employment (all sectors, self, business, management, research etc.) of 4612.5 million man days a year in connection with major forest produce. (Ranganathan G.S. (1979) Agro-forestry: Employment for millions, printed in India by Tata Press Ltd., Bombay) consider Agro-forestry as the only possible means for meeting the challenge of unemployment. According to him 7 million people enter the job market every year in India, at best industry can provide jobs for ½ million the unemployed 53 million (1976) have to find employment elsewhere. Forestry and Agro-forestry section which has unlimited opportunities spread over about 229 million hectare of agricultural and forest lands could take care of 30 million people for effective land management.

Conclusion

To achieve the stupendous task of creating a healthy environment it is desirable to educate the people of all levels, ages and sex about environmental degradation in rural and urban areas, create environmental awareness and consciousness and last but not the least an action oriented environmental conservation movement supported by social/voluntary organisations and movements, educational institutions, national and international agencies, scientific bodies, organisations and the Governments.

Acknowledgement

I wish to thank you ladies and gentlemen for patient hearing you have given and for the interesting and lively discussions.

I thank the Wildlife Preservation Society of India for inviting me to deliver this talk and also to Sarwashri Naveen Jain, D.K. Sharma of F.R.I. and Colleges, for assistance in arranging this illustrated talk.

The Environmental complex

1. Cosmic radiations
2. Solar radiations
3. Light
4. Geographical location and topography
5. Temperature
6. Atmospheric Composition
7. Gravity Rotational pressure
8. Geology and Mining Management
9. Soil and its management
10. Water and its management
11. Plants and their management
12. Animals and their management
13. Fire and its management
14. Industry and its management

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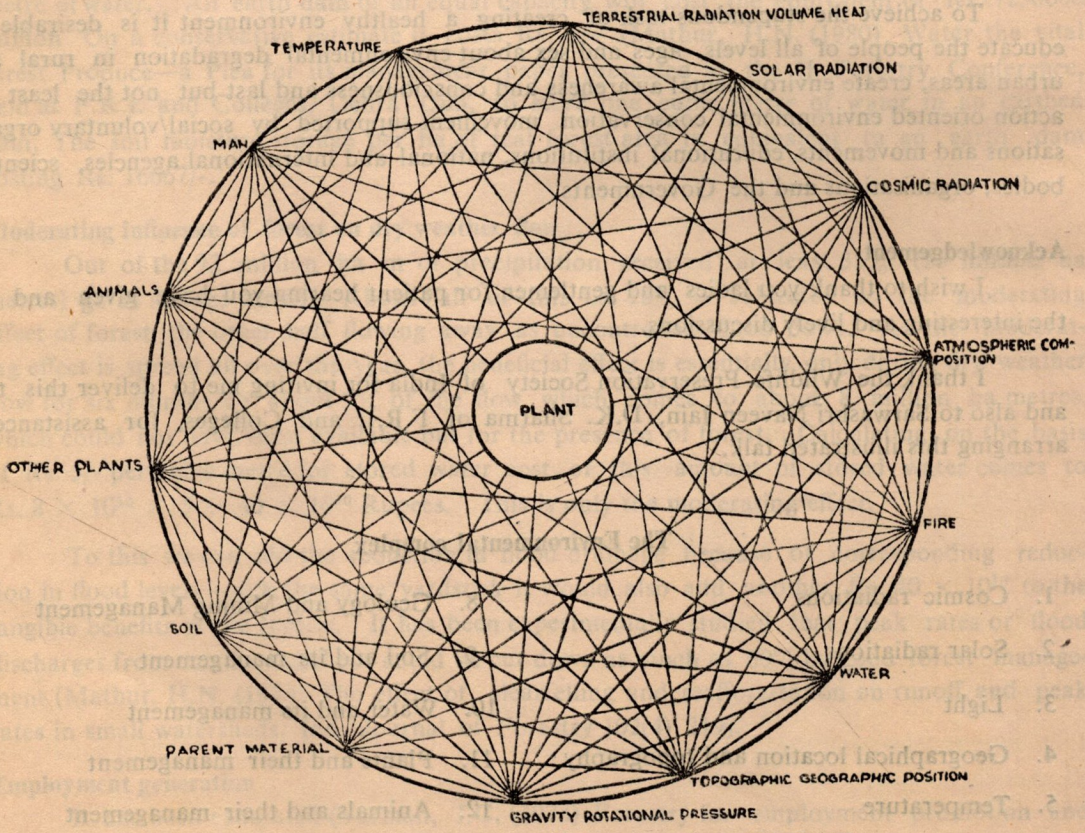

SOURCE- MCGRAW HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY VOL 5 PAGE-12

Himalayan Musk Deer, India

WORLD WILDLIFE FUND PROJECT NO. 1328

By

M.J.B. Green

Introduction

The Himalayan musk deer occurs between 2,200 m and 4,300 m and used to be widespread from Pakistan, through N. India and Nepal to Bhutan and Burma, extending into parts of Tibet and S.W. China. Little was known about this primitive deer apart from its ruthless persecution for the musk.

This gelatinous, brown secretion (white in juveniles) is contained within a pod (gland) which occurs only in males and weighs 20-40 g. Musk has been valued for its cosmetic and alleged medicinal properties for centuries.

Research

In 1979 the World Wildlife Fund, in collaboration with the Government of India, initiated an ecological study of this 'threatened' species to determine its conservation requirements. The project is based in the Kedarnath Sanctuary, Uttar Pradesh where it benefits from the full support of the Chief Wild Life Warden. Moreover, the Wild Life Preservation Organisation, Lucknow, is establishing a musk deer breeding farm on the periphery of the sanctuary.

Research indicates that musk deer are solitary animals which maintain discrete ranges at a density of 3-4 per sq. km. Typical habitat includes oak (*Quercus semecarpifolia*), fir (*Abies pindrow*) and birch (*Betula utilis*) forests, rhododendron (*Rhododendron cinnamoneum* and *R. campanulatum*) and juniper (*Juniperus* spp.) scrub, alpine pastures and cliffs. Musk deer remain concealed in forests or scrub in day time and emerge after sunset to graze the alpine pastures. Using a nightscope, animals have been observed to alternatively rest and feed throughout the night.

The onset of winter is no cause for migration as musk deer are well adapted for survival in snow conditions. Their hair is peculiarly thick. When viewed under a scanning electron microscope it is seen to consist of air-filled cells which must provide good insulation (A.N. Singh, unpubl.). The well developed lateral toes displace the body weight over a larger surface area and thereby minimize sinking in soft snow. The lower incisors are spatulate which facilitates the removal of lichens and mosses from the surface of rocks and trees when other vegetation is snow-covered.

During 1981 a number of musk deer will be radio-collared in order to monitor their movements and activities.

Musk Trade

In spite of the banning of the musk trade, it persists on a large scale virtually unabated. Musk fetches Rs. 250,000 per kg (U.S.$ 31,250) in India, where it continues to be used in ayurvedic and unani medicines, and U.S. $ 40,000-50,000 per kg on the international market.

Unofficial sources claim that the international trade in Himalayan musk is about 180 kg per year, all of which is routed via Hong Kong. This represents an annual slaughter of 4,500-9,000 male animals and excludes females and juveniles which are killed indiscriminately. About 15% of this musk (20-40 kg per year) is used in Europe and America for perfumes and the rest is used for medicines in Japan.

Conservation

Successful conservation of the species will depend on implementing the following:-

1. Protection of musk deer within existing national parks and sanctuaries.
2. Control of the musk trade at national and international levels.
3. Education of the public with regard to the plight of the musk deer.
4. Research into the alleged medicinal properties of musk.

Conclusion

Synthetic alternatives have replaced natural musk to a great extent in perfumery. The continued use of musk in cosmetics is an ill-afforded luxury.

The importance of musk within indigenous systems of medicine may have been over-rated and requires further research. If the medicinal value of musk is proved on scientific grounds, then farming the species* will be justified and even greater importance will be attached to the conservation of the species in the wild.

———

*It is not necessary to kill the animal to obtain the musk. Gentle pressure on the musk gland will release the secretion via its external orifice.

SILENT VALLEY:

Predator Trail—a saga

BY

E.R.C. DAVIDAR

[While every article that has been written about the silent valley deals with the floor of the valley the contributor who is closely associated with the Nilgiri Wild Life Association and who is a consultant to the Survival Service Commission of the IUCN writes about the rim of the valley bordering the Nilgiris and takes a look at the valley from the top.]

Shikari Joe was leading the column with me close on his heels when, without warning, Joe fell backwards and rammed into me, as if someone had given him an upper cut on the jaw. The next instant the fetid breath of a startled tiger and its surprised 'wouf, wouf' hit us. Luckily the tiger also somersaulted backwards instead of charging forward. By the time we recovered from this unexpected meeting and grabbed our rifles the tiger was bolting away and had reached the security of the nearest shola. This was over twenty years ago when tigers were not even classified as game, but were considered vermin !!

Later, on the same trip, within a stone's throw of the same track, a wounded tiger mercifully spared my life and that of my friend Charlie Minchin. But that is another story. Since then my contact with tigers on this trail has been through their markings and other evidence of their presence left on it.

The track we were on was the briddle path leading from the plains of Malabar to Ootacamund through the Sispara pass, one of the earliest routes to be opened to the Nilgiri plateau. This was in 1838. While the main track carries on towards Nilambur, game trails drop into the Silent Valley. The Kundah ghat, as it was originally known and which was mostly used as a tappal route—giving rise to place names such as Bangitappal, was abandoned in 1844 because of the severity of the climate. To me this is 'predator trail'. The bridle path which was never made into a motorable road, traverses miles of open grassland interspersed with evergreen sholas, at an average elevation of 2100 metres. This country is one of the largest wilderness areas left in South India and the only mode of transport there is a pony or one's own two feet. Camping out under canvas is the best way to enjoy this wilderness.

When I traded the rifle for the camera to hunt big game, predator trail, understandably, became my haunt whenever I visited the area. Professional shikar guides have told me that the area around the track was the favourite hunting ground of famous hunters. It is said that the Prince of Afghanistan who was interned in the hills during the last World War, whenever he was allowed freedom, spent long hours watching the track for migrating tigers.

As far as I am concerned the most notable user of the track was a black leopard which when I last saw it in 1975 was getting on in years, as its greying muzzle indicated and might, perhaps, have passed on by now, was the most frequent user of the track. It has no doubt left its genes behind, a black leopard among its progeny to traverse the trail.

During the course of Nilgiri tahr studies I use the track for collecting and examining samples of predator faeces to determine their prey species. Wild dogs also use the track on their migrations from the plateau to the jungles in Kerala including the Silent Valley and vice versa. With 'Development'—a quesitonable achievement where it involves the denudation of valuable forests—of the Nilambur region, the Upper Silent Valley's role as a predator repository of the region becomes vital. And predators' place in the ecological pyramid and their role in nature are too well known to be gone into here.

The line of demarcation between the Silent Valley and the Nilgiri plateau on the South West (of the Nilgiris) is practically non-existent on the ground. During the 1975 tahr census observing three magnificent saddle backs on an out crop of rocks, I decided to stalk them to get a close-up. It was a long stalk across two ridges. But I bungled it at the last moment and my scent gave me away. The animals took off, down a valley and across the border, into Ankinda malai, in Silent Valley and disappeared from view. On another occasion when poachers were active on the upper ridges of Ankinda (the peak rising to an elevation of 2383 metres above sea level) the tahr had deserted the Silent Valley ridges and moved into the Nilgiri plateau. This two way movement has been a factor of great value to wildlife in the area. It helped them to move away from danger coming from either direction and made it possible for them to establish themselves, and keep gene pool viable.

The upper crust of the Silent Valley where it joins the Nilgiri plateau is a wilderness area in the true sense, wild, uninhabited and seldom approached by man. Poachers could have a free run of the place unless constantly watched. And this is by no means easy. Because of impossible weather conditions at times and the distance from forest administrative centres on either side it is difficult to patrol the area and exercise proper control and supervision.

Last year in the course of a Nilgiri tahr status survey which I had undertaken over its entire range, while approaching the Silent Valley's upper ridges from the Nilgiri side my men and I made a startling discovery—a well set up poaching camp on the Nadganimattam on the Nilgiri/Kerala border. They made a cane ropeway over the cliffs to reach the tahr country in double quick time ! Seeing us the poachers had abandoned their camp in haste. Prompt action and intensive patrolling in which the forest departments of Kerala and Tamilnadu and the Nilgiri Wild Life Association co-operated and co-ordinated their efforts brought this organised poaching to an end. But sporadic poaching goes on.

Should the attempts to save the Silent Valley fail and should the Valley be opened up, its effect on the Upper Silent Valley/South West Nilgiris plateau complex will be direct and immediate. A new and easy route will be available to the poachers to the detriment of the Nilgiri tahr and sambur populations there. One of the few remaining refugium of our magnificent larger predators will cease to offer them refuge. In the long run the viability of the predator gene poll will be affected. And there will be no migrating tigers, leopards and wild dogs to walk the 'predator trail'—which will, indeed, be a sad thing.

———

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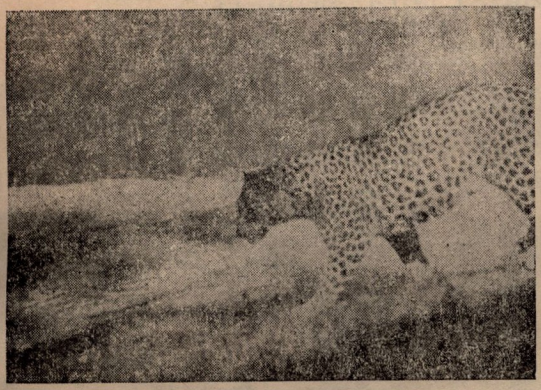

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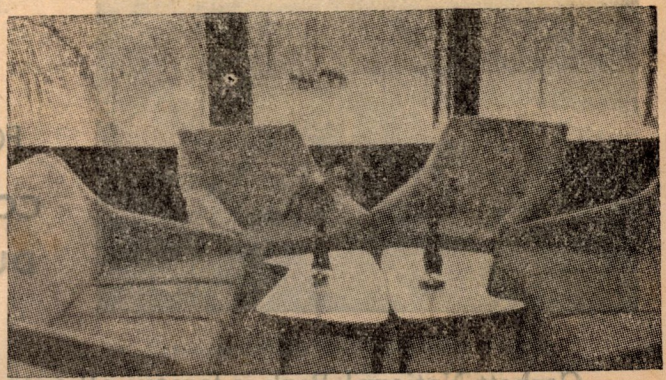

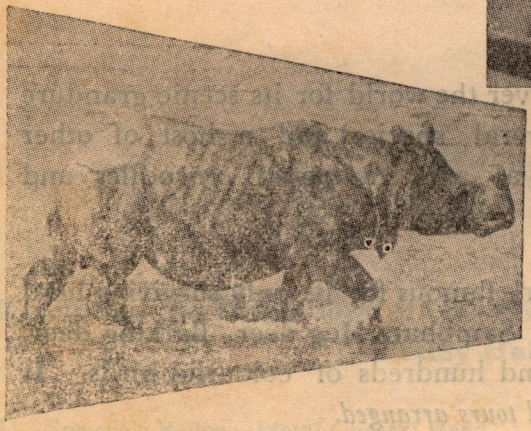

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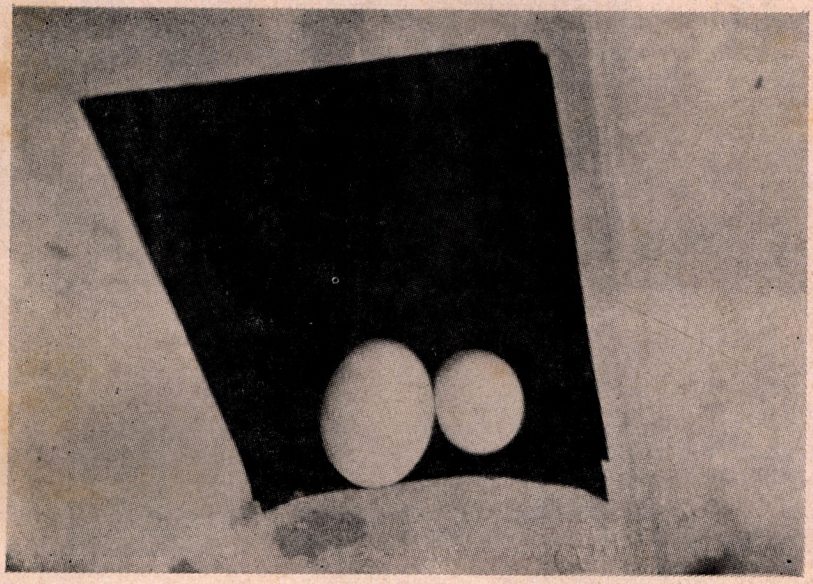
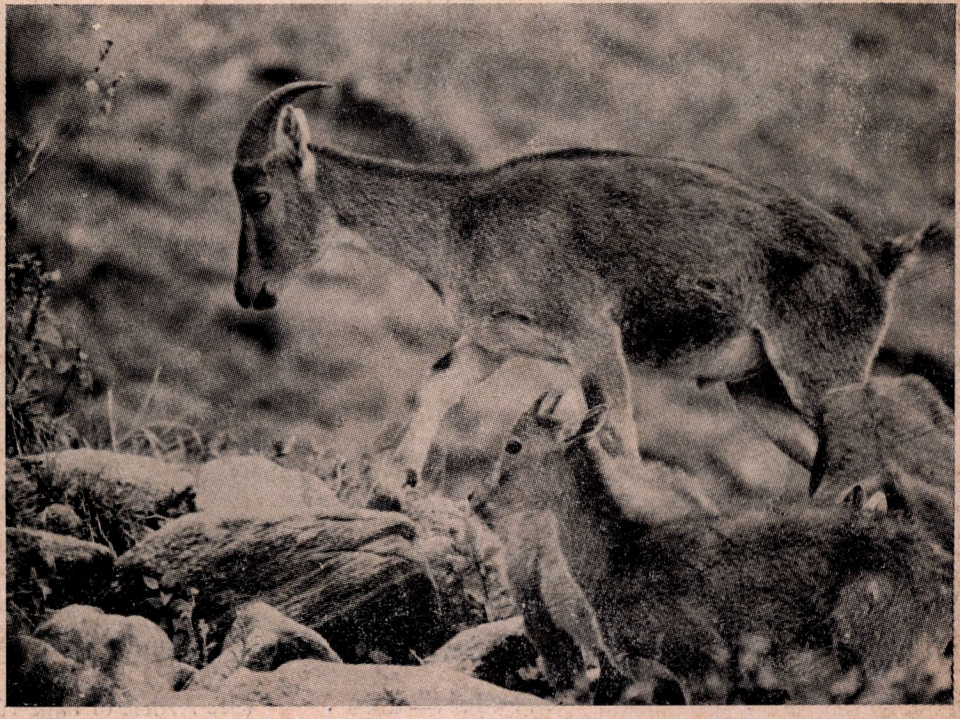


घड़याल व मगर का अण्डा

पलते घड़याल—शावक

(See Article of Page 16)

(Styam) 6½ year old ♂ musk deer 26/1/80 Kufri—Himachal Pradesh.
(Article on Page 63)



Nilgiri Tahr. (*Photo: E.R.C. Davidar*)
(Article on Page 65)